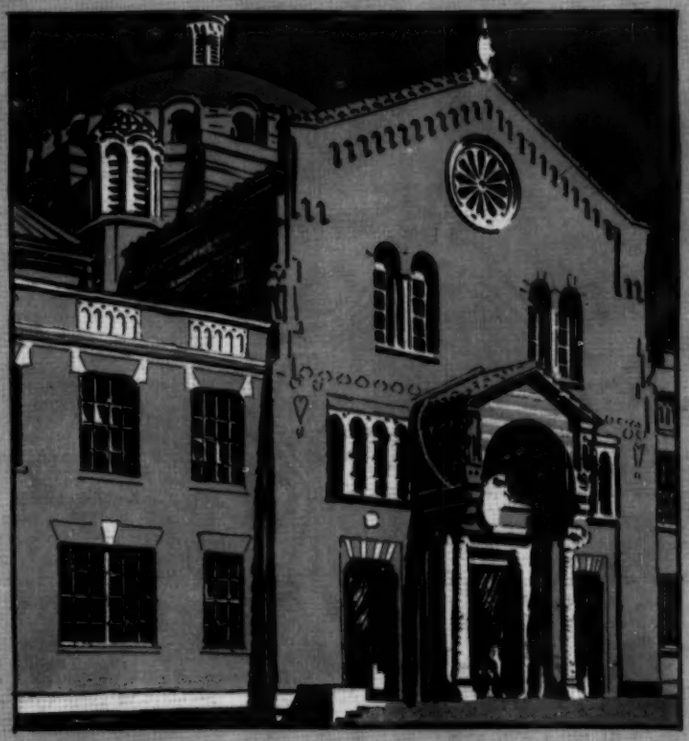
MAR 23 1928

THE ARCHITECTURAL FORUM

IN TWO PARTS



PART ONE
ARCHITECTURAL DESIGN

MARCH
1928

SCHOOL BUILDINGS REFERENCE NUMBER

Announcing

THE COMMON BRICK SCHOOL BUILDING COMPETITION

for PHOTOGRAPHS *and* PLANS *of* SCHOOL BUILDINGS
Having Exteriors Constructed of Common Brick*

Competition Closes November 6, 1928

PRIZES

This Competition and its Prize Awards are divided into two classes, as follows:

****GRAND PRIZE $500**
for the best building in either class

CLASS A		CLASS B	
FIRST PRIZE	$500	FIRST PRIZE	$500
SECOND PRIZE	250	SECOND PRIZE	250
THIRD PRIZE	100	THIRD PRIZE	100
FOUR HONORABLE MENTIONS	50 EACH	FOUR HONORABLE MENTIONS	50 EACH

*DEFINITION: A common brick, as defined by the Common Brick Manufacturers' Association of America, and for the purposes of this competition, is a solid building unit of burned clay having a natural surface not treated to produce special effects in color or texture of the individual brick but including "clinker," overburned, and "cull" brick. Types of common brick construction and finish admitted in this competition are explained in the following conditions and in the accompanying booklet.

**This grand prize will be awarded by the jury after selecting the first prize winner in each class. It will be awarded in addition to the first prize, making a total prize of $1,000 for the best entry in the entire competition.

THE first and second Common Brick House Competitions, held during 1926 and 1927 developed such widespread interest that architects in all parts of the country submitted photographs and plans of many of the finest common brick dwellings that have been erected in recent years. The response from the architectural profession has definitely proved the popularity and value of these competitions.

These two competitions have for the time being quite thoroughly covered the field of house design. It has been decided to conduct a competition in 1928 which will cover the very interesting field of school building design.

All types of school buildings in which the majority of rooms are used for class-room purposes may be entered in this competition, provided 75 per cent of the exterior walls is surfaced with common brick. Small or large school buildings have an equal chance to win the award in this competition for the prizes have been divided into two classes, as given below, Class "A" calling for buildings of limited volume, and Class "B" permitting the entry of the larger buildings which necessarily offer the architects a broader opportunity for fine treatments of mass and detail than is generally accorded the designer of small structures. A grand prize is offered, which will be awarded to the first prize winner in either class whose entry is judged the finest submitted in the entire competition.

The division of school buildings and prizes into two classes is made on the following basis:

Class A—School buildings having an actual cubic foot volume not exceeding 700,000 cubic feet.

Class B—School buildings having a cubic foot volume in excess of 700,000 cubic feet.

It should be noted that the buildings shall be those used predominantly for class-room purposes, which excludes structures used solely as dormitories, libraries, gymnasia, and other accessory buildings. It would include, however, buildings which may contain these facilities as accessories to space devoted primarily to instruction purposes. The competition is open to public, parochial, and private school buildings and buildings for preparatory schools, colleges and universities, falling within the limitations above defined.

This third Common Brick Competition, like the preceding competitions, is quite simple in its nature, because instead of sketch plans requiring extensive drafting-room work and new creative designing, it calls for photographs and floor plans of school buildings already constructed or which may be completed in time to submit the required entries before the closing date, NOVEMBER 6, 1928. From the point of view of the architect, it should prove to be an interesting type of competition because it requires comparatively little time, the project resolving itself into the simple procedure of obtaining good photographs and submitting them with floor plans and the cubic footage.

Send for Complete Announcement and Program Containing All Conditions of the Competition

This competition closes NOVEMBER 6, 1928 *and is conducted by*

THE COMMON BRICK MANUFACTURERS' ASSOCIATION *of* AMERICA
Guarantee Title Building, Cleveland, Ohio

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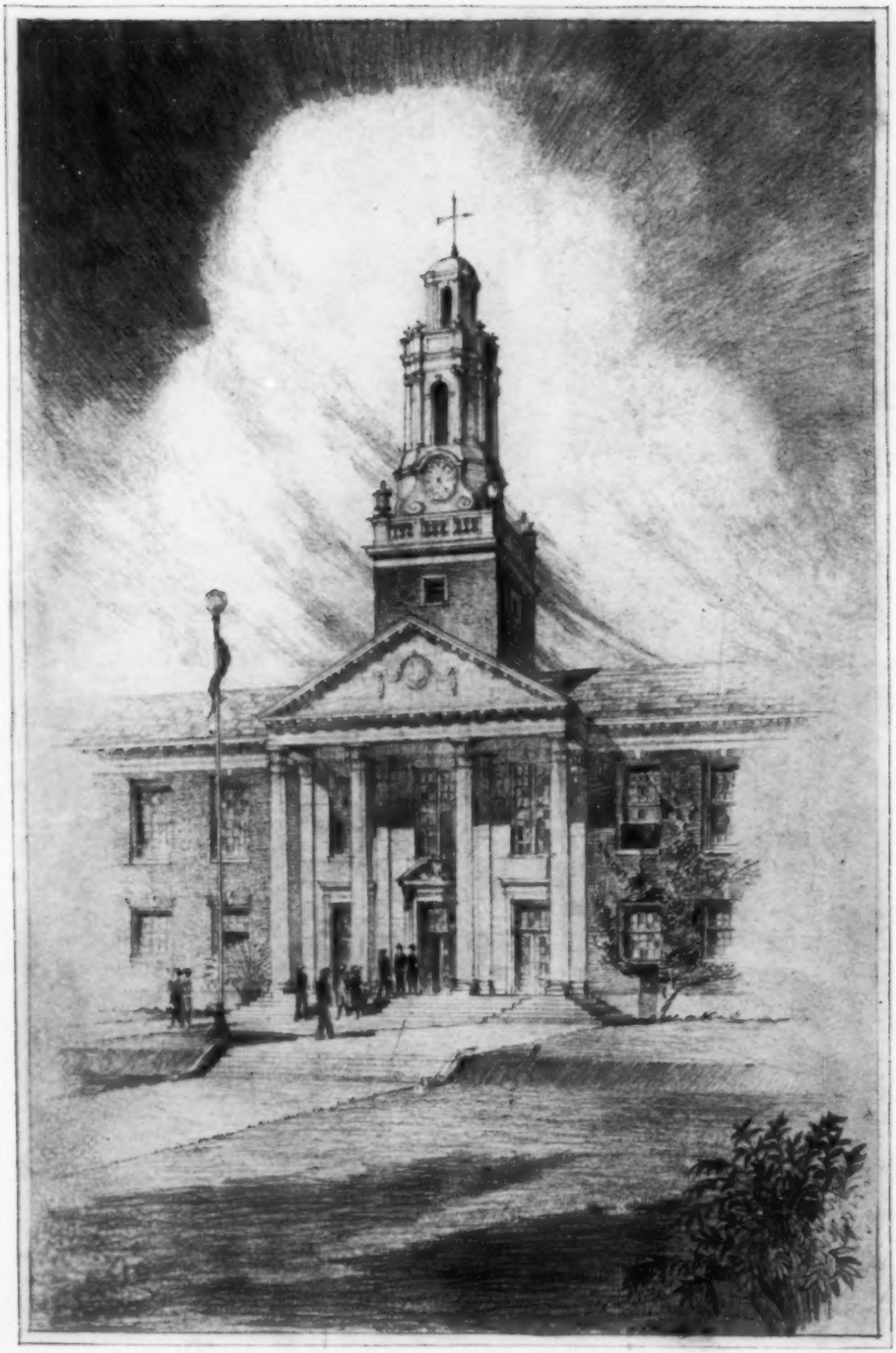
QUARTERLY REFERENCE NUMBERS

IN August, 1922 THE ARCHITECTURAL FORUM published the first of its Quarterly Reference Numbers. Since then 22 of these numbers have appeared, and the first cycle has been completed. The subjects starting with the present issue, devoted in its entirety to Schools, will be repeated, thus bringing the architect up to date on the major developments which have taken place in the intervening six years.

The classes of buildings to be covered are Banks; Country Houses; Hospitals; Industrial Buildings; Hotels; Churches; Shops and Stores; Office Buildings; Apartment Hotels; Golf and Country Clubs; Motion Picture Theaters; Apartment Houses; University Buildings, in two parts; Small Houses; Club and Fraternity Buildings; Memorial Structures; Automotive Buildings; Public Buildings, in two parts; and Libraries and Museums.



ENTRANCE PORTICO AND TOWER
COMPLETE SCHOOL, LONGVIEW, WASH.

WILLIAM B. ITTNER, ARCHITECT

FROM A PENCIL SKETCH BY A. L. MARTSOLL

UNIV. OF MICH.

THE
ARCHITECTURAL
FORUM

VOLUME XLVIII NUMBER THREE

MARCH 1928

FUNDAMENTALS IN PLANNING SCHOOL BUILDINGS

BY
WILLIAM B. ITTNER, ARCHITECT

PRESENT-DAY educational objectives,—health, the fundamental operations, citizenship and worthy home membership,—constitute the initial considerations and the all-important fundamentals in present-day school house planning. These objectives have been generally accepted as goals of education, and school communities of the country have reorganized and expanded their curricula in order that these objectives may be brought to realization. Concretely stated, city and town schools are offering physical education and health activities, expanded science courses and social studies, a variety of workshop activities, diversified music and art courses, and many kinds of work that relate directly to home enrichment. Yet, although practically all school communities have expanded their educational programs in line with the comprehensive objectives, no two curricula are alike. Some schools, especially in industrial communities, stress vocational activities; some give far more time and attention to health and physical education than others; some place emphasis on music and art and the formal classroom work.

School building policies, as well as educational programs are variable. In many communities, the tendency toward centralization, viz., the building of larger and fewer schools, prevails; in other words, the policy of combining all grades in one school is dominant. For instance, Gary, Indiana has pursued this complete school plan for the past 20 years. Greenfield, Ohio and Longview, Washington have recently adopted the policy. In most cities and towns, however, there is still much segregation of grades into elementary, junior and senior high schools.

The Test of the School Architect of Today. The real test of an architect's ability to plan schools rests principally on his skill in adapting a building plan to a particular program, so that the building will give 100 per cent educational service. The variation in curricula, in methods of school procedure and in building policies, makes every school building an individual problem. Every building plan is or should be the result of the creative thought of the architect. An attempt to standardize a school building plan is as absurd as an attempt to standardize painting and sculpture. Standards have been developed as guides to safety, lighting, ventilation and sanitation of schools. These are of service to the less experienced architect. To the master school house planner, however, the mechanical elements are incorporated in the plan almost unconsciously. He knows them so well that they are really in the background of his thought, just as proportion, balance and symmetry are automatic with the skilled artist. If a school building plan is successful in meeting the diversified educational program, if the building gives maximum educational service, safety, good lighting and ventilation, economy and beauty should follow as a natural outcome. On the other hand, a building may conform to every rule for the mechanical elements and be a failure as an adaptation to the educational program.

The School Architect and the School Superintendent. A school architect cannot be expected to interpret the curricular offerings and proposed organization of individual schools. He may know in a general way that physical education, the fundamental operations, shop work, music and art are offered. He may know that auditorium work for special groups is desired. But he doesn't know how classes are to be grouped for the diversified activities, nor about the time allotments. He must depend on the superintendent and his assistants for the interpretation of the curriculum and operating program. The educationists and the architect together must evolve the extent of health and recreational quarters, the number, sizes and correlation of classrooms, laboratories, shops, home economics quarters, auditoriums, music and art rooms. Following this preliminary study, the building becomes almost entirely the architect's responsibility. His chief problem consists of weaving all the requirements into an ensemble plan that will function educationally and at the same time stand as an engineering and architectural success.

Important Considerations in Plan Development. There are several elements that must be considered in developing a school plan from a list of educational requirements. The first of these is climate. The general type of plan, height of building, lighting and ventilation, size of health quarters and kind of building materials are all affected by climate. In the South and in California, for instance, the plan should be

Exterior View and Library, Complete School Group, Greenfield, O.
William B. Ittner, Architect

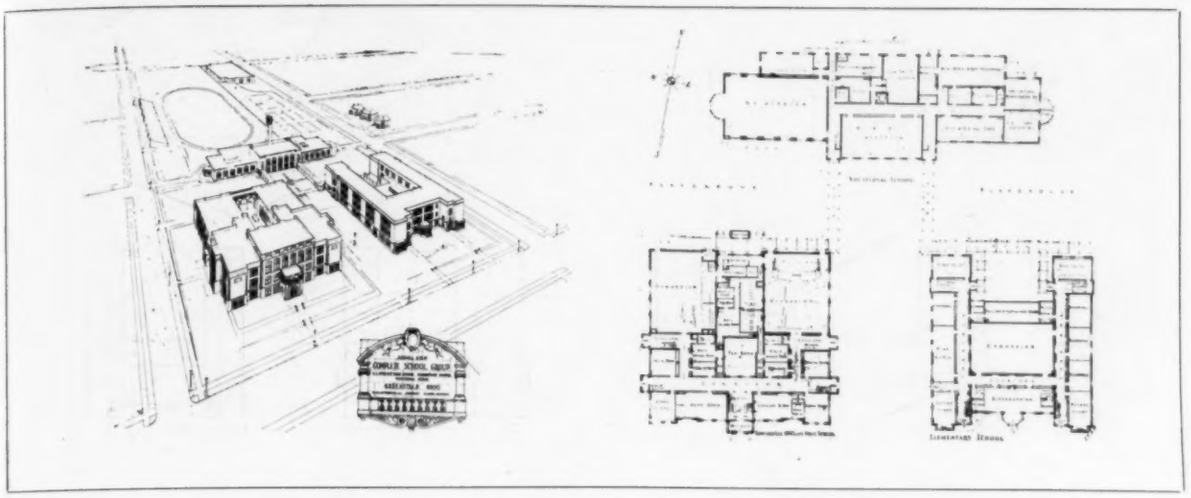
as open as possible. The building may be one or two stories in height; less window area will be required, and window ventilation may suffice for the entire school year. The health quarters may be minimized, due to the all-year-round out-of-door play. Construction, although durable and fire-resistive, may be lighter. The architecture should exhibit the influence of the traditions of that part of our country. In the Middle West, North and East, school building plans are of a more compact type. As a rule, they cannot be spread out as much as in the warmer climates, owing to the long runs of heating pipes and to the large areas of exposed wall surface. The buildings are usually two or three stories in height, the window areas should be greater than in the South, and full indoor health facilities are essential. Window ventilation, except occasionally, is not practical. The most efficient type of heating and ventilating apparatus becomes a requirement. Construction must be heavier, brick being the preferred material. The architecture in most cases becomes an adaptation of Colonial, Tudor or Georgian.

Site conditions constitute a second important consideration in planning of schools. A restricted site calls for a closely knit plan and additional height. These plan requirements bring about diverse problems in safety, lighting and ventilation aside from the problem of the varied educational quarters. Frequently the site is of sufficient size for an "open plan," two-story building, but it may have peculiarities of grades and an abrupt slope. Such a situation will present an entirely new problem of planning for educational service in addition to the mechanical and architectural features of the building. A consideration which architects are altogether too likely to overlook or neglect is that of plan elasticity and possibilities of expansion. School buildings today are fire-resistive and durable. Most of them will stand the test of a century. Educational thought and practice, however, are constantly changing, and enrollments will increase from year to year. Possibilities for expansion and alterations should be inherent in every original school building plan. Wherever possible within the building, units should be planned so that they can be enlarged or decreased in size. The locations of supporting walls, the arrangement of the classroom units and the grouping of special rooms all have an important bearing on the matter of elasticity of building plan.

Classification of American Schools. American public schools are classified generally as rural, elementary and secondary. There are variations of these. The rural school may be a one-room school or a consolidated school, serving several rural districts. The elementary schools include the first six, the first seven or the first eight grades and kindergarten. Secondary schools include four or six upper grades. If the latter, they are designated as junior-senior schools. There are also secondary schools known as technical high schools and vocational high schools. In several of our largest cities, high schools have been segregated into separate buildings for boys and girls.

The Rural School. The ideal rural school situation is represented by the centralized complete school at Greenfield, Ohio (page 306). Greenfield has a population of about 6,000. It is surrounded by a rich agricultural country. The one complete school, centrally located and with playground immediately adjacent, serves not only the children of the town but the children from 17 rural districts. At this school the children may enjoy an enriched education in a beautiful environment, under the influence of a high type of teacher, and still live in the country and enjoy God's great out-of-doors. Greenfield has set an example which may well be followed by the small towns of our country. The three-building school group at Greenfield serves a district of approximately 100 square miles in extent and has accommodations for 2,200 students from the kindergarten through the high school. The school population is now 1,800. One thousand, two hundred of these students belong to Greenfield; the remaining 600 are transported from the 17 adjacent rural districts in motor buses. There is thus a leeway for growth of 400 students.

For its program of health the schools include:



Perspective and Plan, Complete School Group, Greenfield, O.
William B. Ittner, Architect

1. A high school gymnasium (65 x 90 feet) provided with seating capacity for 1,000 spectators, locker and shower rooms and accessory rooms for home and visiting teams.

2. An elementary school gymnasium (52 x 80 feet) for grades three, four, five and six and a playroom for the youngest children in grades one and two.

3. Two tile-paved, open-air gymnasiums, each 90 x 60 feet, and an athletic field with provisions for all major out-of-door sports,—football, baseball, track and tennis.

4. A swimming pool (32 x 75 feet),—the largest ever installed in a public school building,—equipped with ultra-violet ray process for water purification. The pool room expands into a sun parlor at one end, and provisions have been arranged for 800 spectators. A laundry and a full complement of lockers and showers make up the accessories.

5. A home hygiene room and adjacent clinic for examination, first aid, and for instruction in cleanliness, sanitation and home nursing.

6. A cafeteria seating 250 at a time, for those who remain at the school all day.

The accompanying plans illustrate the arrangement of the facilities for the fundamental operations:

1. In the elementary school, the kindergarten, which is a double unit (22 x 50 feet).

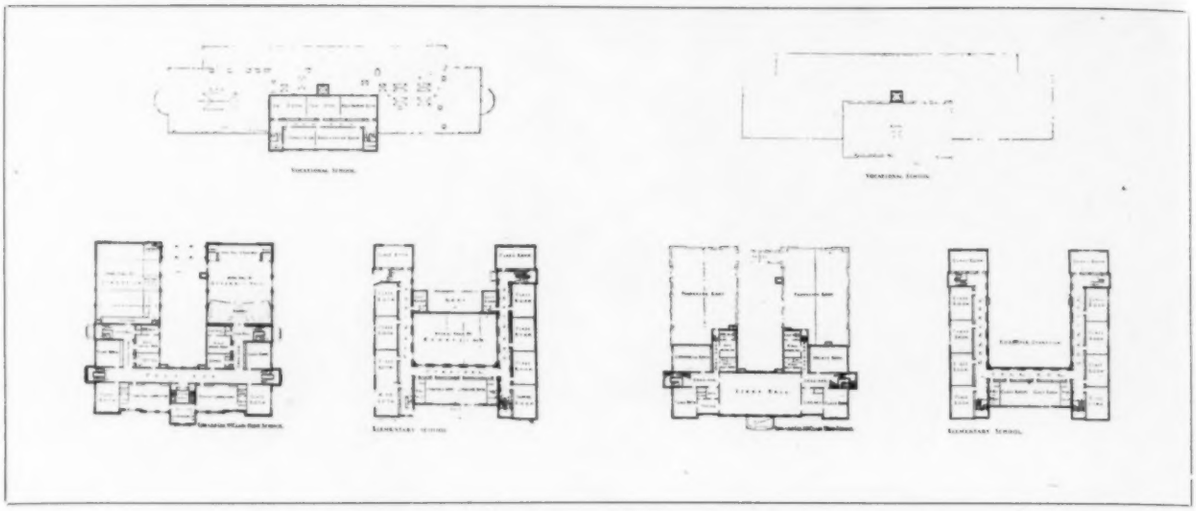
2. Eighteen classrooms, each with dimensions 22 x 32 feet. Owing to the organization of the elementary school on the work-study-play plan, only half the usual number of classrooms are required.

3. The ten classrooms in the high school are varied in size, owing to the variation in size of classes.

4. There are two libraries, a small room accommodating 70 pupils at a time in the elementary school, and a large room (42 x 82 feet) in the high school.

The high school library (page 306) is probably unrivaled as a beautiful room for its purpose. The plan, the unusual proportions and the lighting give it charm and an atmosphere of cheerfulness and spaciousness rarely achieved. The walls, a neutral tone, are book-lined on three sides. A number of Caproni casts appear in appropriate settings, and the upper end panels have been embellished by two of Vesper Lincoln George's murals. For the purpose of socializing and integrating the work of the school, two auditoriums are provided,—one for daily auditorium work with small groups is located in the elementary school, and the other, with capacity for 1,000, including a large stage and equipped with motion picture machine, radio outfit and magnificent pipe organ, is located on the main floor of the high school. Two of the three buildings of the Greenfield group,—the high school and the vocational building,—are the gifts of E. L. McClain, citizen-philanthropist of Greenfield. The elementary unit for the first six grades and kindergarten was erected by the board of education. Mr. McClain equipped all three of the schools. His gifts of sites, and athletic field, murals, paintings and sculpture are in addition to the two buildings and equipment. The combined cost of the three buildings without grounds and equipment approximates $950,000, yielding a per-pupil cost of $432, as the school plant will normally accommodate 2,200 students. When consideration is given to the fact that there are schools in the country with $1,000 per pupil costs, not offering the enriched educational opportunities described, the significance of the Greenfield school is apparent.

At Deering, Missouri is an example of consolidation on a small scale. This school is located in a village and serves as the center for the educational and community activities of the district. Although the accommodations of such schools are limited, the quarters may be planned for multiple uses. In the Deering school (page 312) we find a small auditorium which must also serve as the health and cafeteria units, and a limited number of class and special rooms planned and equipped for a variety of uses. The school has a capacity of 360 pupils and was



Plans of the Second and Third Floors, Complete School Group, Greenfield, O.
William B. Ittner, Architect

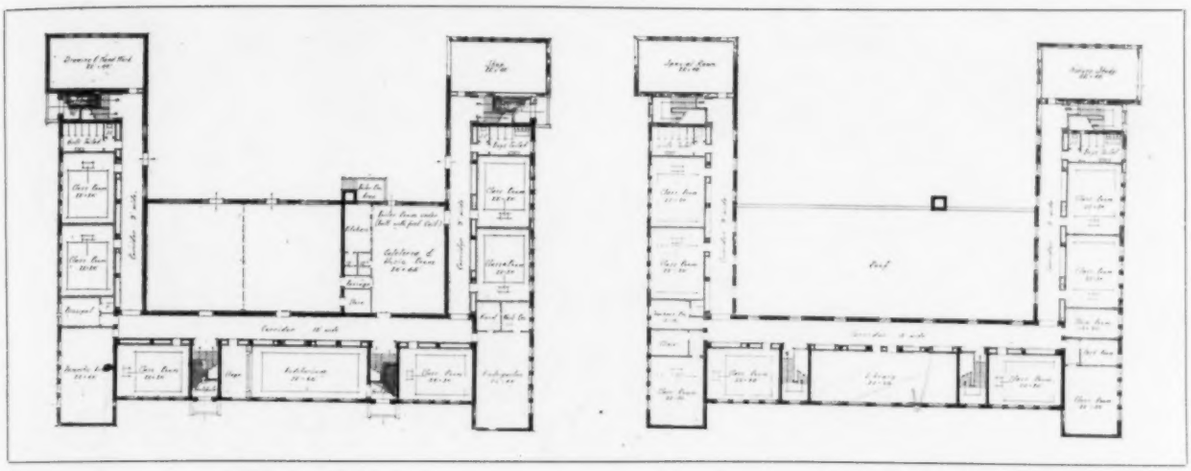
erected at a cost of $58,200 or about $162 per pupil.

The Present-Day Elementary School. The greatest changes in education have probably taken place in the elementary school field. Elementary schools used to be groups of classrooms with perhaps a basement playroom and occasionally a small auditorium which was used only on rare occasions. The buildings were badly planned, improperly lighted, poorly constructed, and most of them were stiff, unattractive, box-like structures. The country owes a debt of gratitude to Dr. William Wirt of Gary, Indiana more than to any other individual for the enriched education the masses of our children are enjoying today. The work-study-play plan evolved by Dr. Wirt has served as the administrative device in making the enriched elementary school financially possible for all school communities. The curricula of elementary schools organized on the work-study-play plan call for health quarters, auditoriums and special rooms for elementary science, handwork and music, in addition to classrooms, but only *half* of the usual number of classrooms are required. A large number of cities and towns of the country have reorganized their elementary schools on the work-study-play or "platoon" plan. The cities include Pittsburgh, Detroit, Dallas, Birmingham, Alabama, St. Paul, Greenfield and Dayton, Ohio. One point about this reorganization is interesting. Although all of these cities have used the same administrative plan as a guide, no two schools are alike. At Birmingham, a typical elementary school plan was developed to serve as a guide for the erection of new schools organized on the work-study-play plan. Yet there were no duplicates. Every school situation presented individual problems of site, pupil enrollments, and variation in curricula and methods.

The typical elementary school plan for Birmingham is interesting. After a survey of building needs, Birmingham re-zoned the school city and adopted the policy of having fewer and larger elementary schools. School units of 1,000 to 1,500 pupils became the basis for the re-districting. Consideration was given to 5-, 10- and 15-year growth. In other words, the school enrollment of a new district at the time of the survey may have been but 500. If the prognostication of growth, however, revealed a school population of 1,000 or more in less than a decade, the typical 1,000-pupil school plan was decided upon for that district although only a section of the building was immediately erected. The typical 1,000-pupil school was planned so that it could be erected in three sections; first the center portion, followed by the wings when enrollments demanded enlargements. The 1,000-pupil school contained a kindergarten, 14 classrooms; a small auditorium; a library; a room for domestic arts, drawing and handwork; nature study and music rooms, and a shop for boys. A playroom was arranged for two classes at a time, and the cafeteria opened upon the playground. The cost of the typical building complete was $225,000, at a per capita cost of $225.

With the traditional plan of organization, about 26 classrooms would have been required for 1,000 pupils. A reference to the plans (page 309) reveals the fact that although only 14 classrooms are provided, the total operating capacity of the special rooms is equivalent to about half the enrollment. This fact demonstrates a working principle of the work-study-play plan by means of a departmental operating schedule which rotates classes from classrooms to special rooms at periodic intervals. Approximately one-half the school is studying in classrooms while the other half is working in the special rooms. Only half the usual number of classrooms therefore are required. It is for this reason that the work-study-play schools can offer children an enriched school life at approximately the same cost as that of the restricted, purely classroom school of the past.

The Goliad School, Galveston (page 310) is an example of the enriched elementary school, organ-

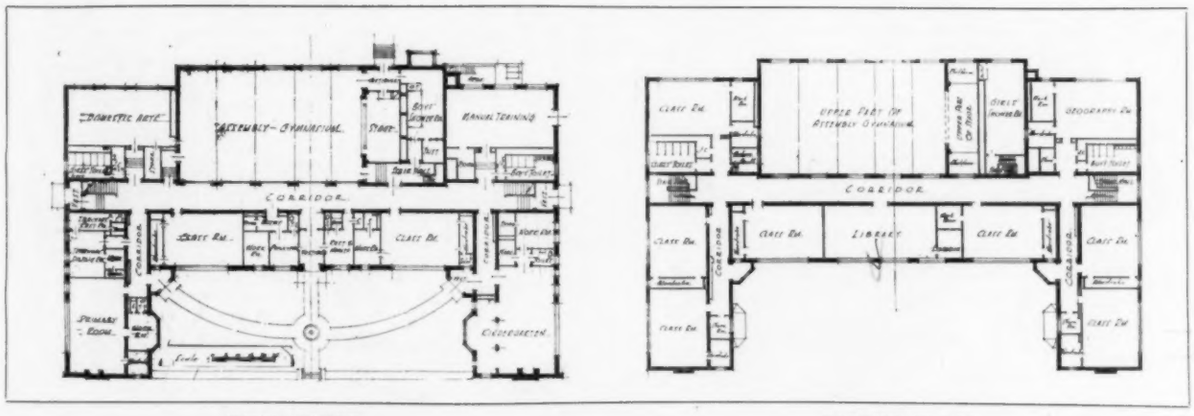


FIRST FLOOR SECOND FLOOR

GRADE SCHOOL, BIRMINGHAM, ALA.

WILLIAM B. ITTNER, CONSULTING ARCHITECT

GENERAL VIEW



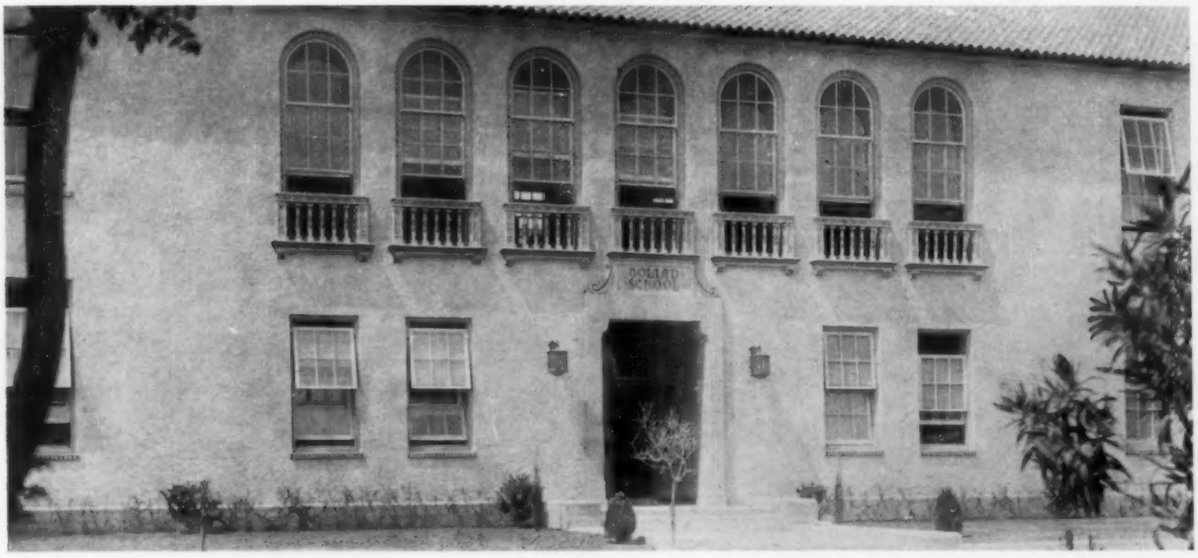
FIRST FLOOR SECOND FLOOR

JEFFERSON ELEMENTARY SCHOOL, BATTLE CREEK, MICH.

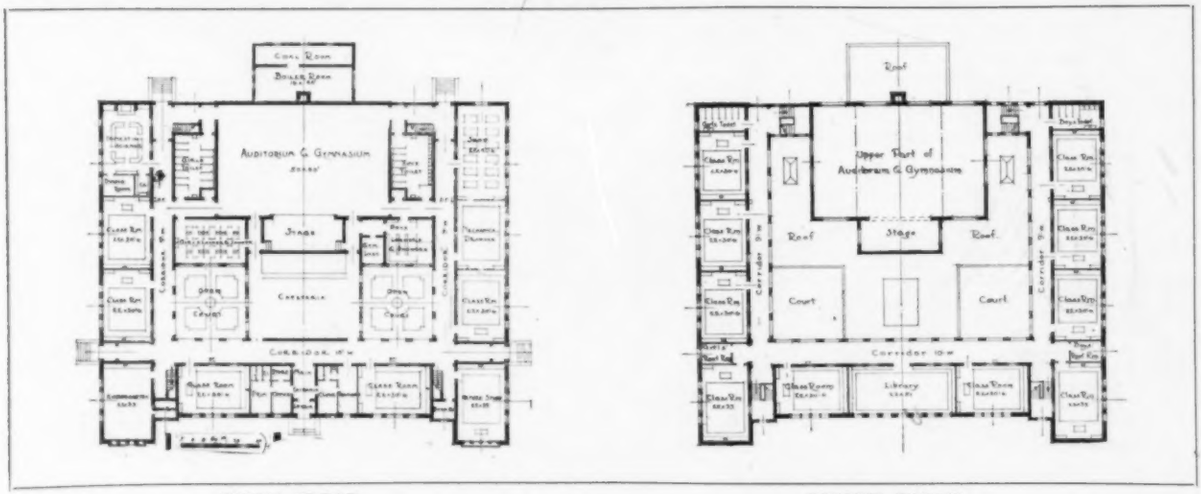
WILLIAM B. ITTNER, ARCHITECT

U. OF MICH.

GENERAL VIEW



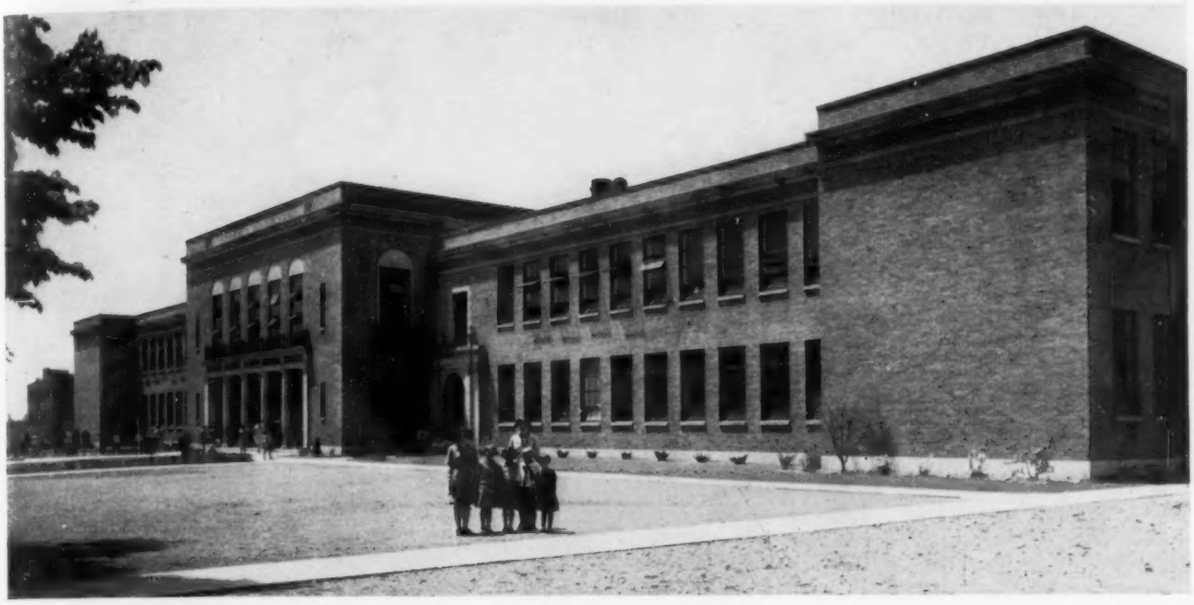
MAIN ENTRANCE



FIRST FLOOR SECOND FLOOR

GOLIAD ELEMENTARY SCHOOL, GALVESTON

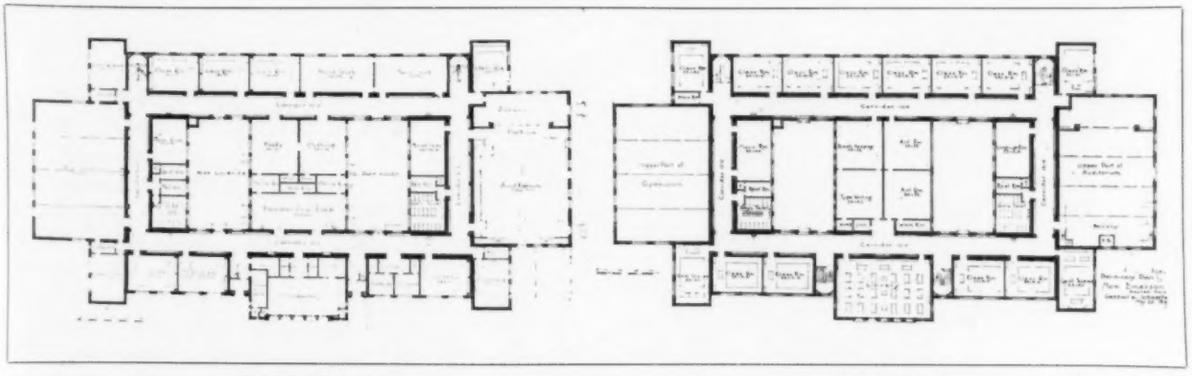
WILLIAM B. ITTNER, DeWITT & LEMON, ASSOCIATED ARCHITECTS



GENERAL VIEW

GYMNASIUM

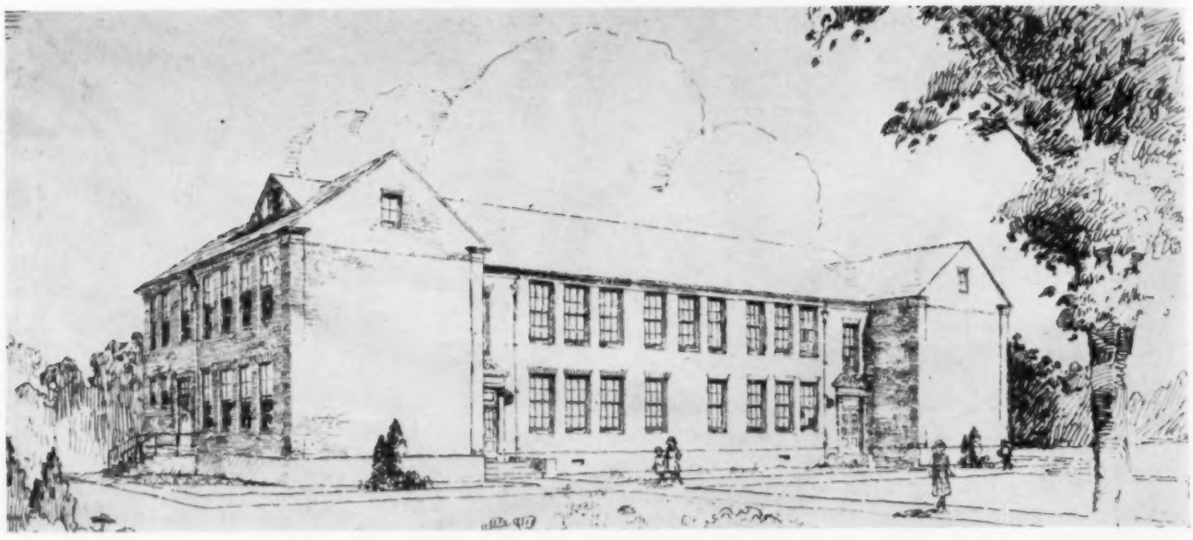
BOYS' GENERAL SHOP



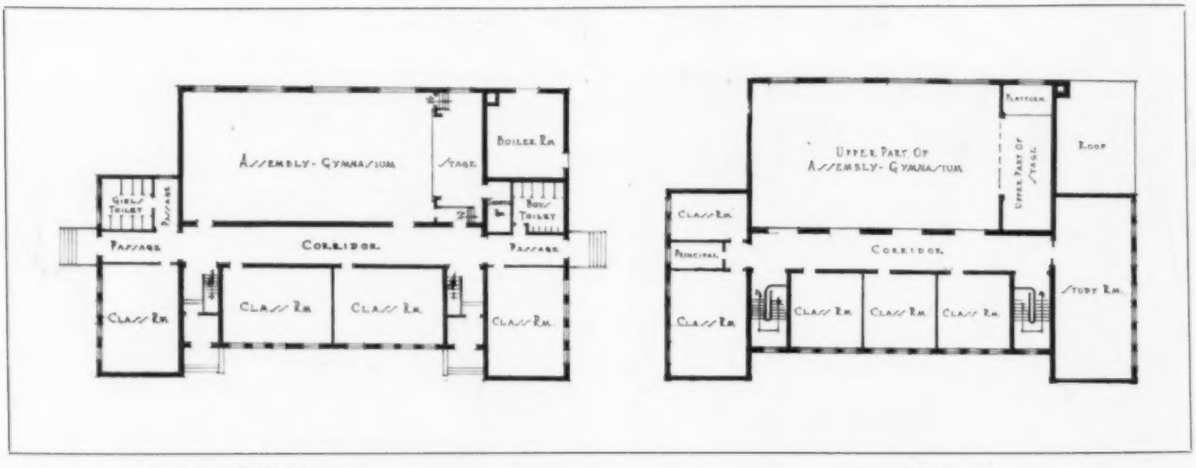
FIRST FLOOR SECOND FLOOR

EMERSON ELEMENTARY JUNIOR HIGH SCHOOL, DAYTON, O.

WILLIAM B. ITTNER, GEBHARDT & SCHAEFFER, ASSOCIATED ARCHITECTS



Pen and Ink Perspective Drawing



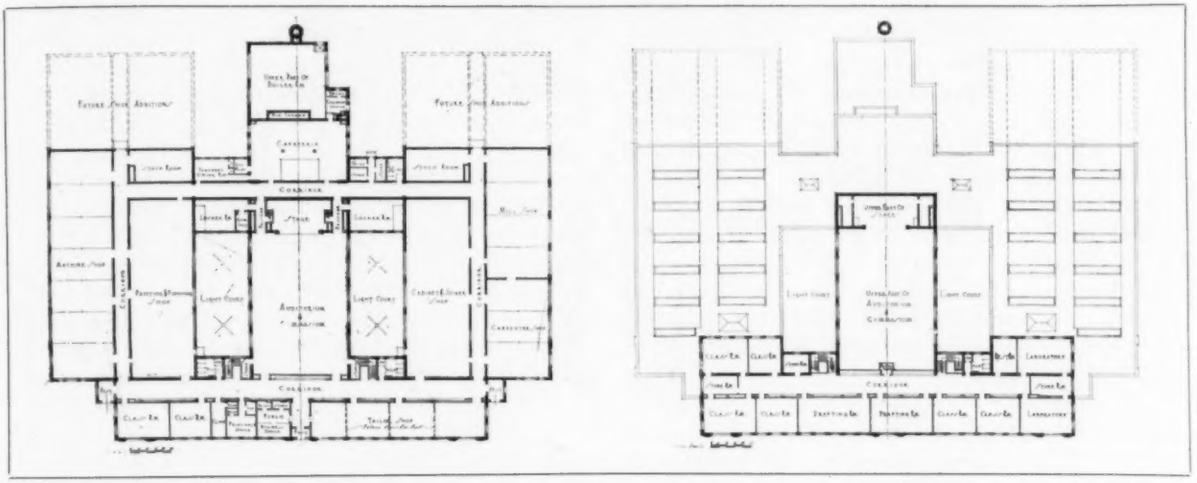
First Floor Second Floor

Grade School Building for Deering, Mo.
William B. Ittner, Architect

ized on a modified work-study-play plan. The climatic conditions prevailing in this gulf port city find expression in a building erected around two open courts or patios, upon which the corridors open to the fullest extent. The desire for maximum air circulation results in giving the auditorium-gymnasium windows on all sides. Windows on the inner walls of all class and special rooms give maximum air circulation to pupils at study or work. As the educational program did not include auditorium work as a daily performance, a combination auditorium-gymnasium was planned for this school with locker and shower accessories. A cafeteria was arranged in correlation. An elementary shop for boys; a domestic arts room for girls; a nature study room and a library-literature room, complete the educational facilities of this school in addition to the classrooms. Like many other buildings in this section of the country, the exterior is designed in the Spanish tradition in stucco and trimmed with polychrome terra cotta. The building complete, without equipment and architects' fees, cost $220,000. The normal capacity of the building is 830 pupils, making a per capita cost of $265.

The Jefferson Elementary School, Battle Creek, Michigan (page 309), although an enriched school differs fundamentally from the Goliad School at Galveston. The plan is of a more compact type. Here again, the climatic conditions have had an underlying influence upon the plan. The difference in the architectural expression of the two buildings is also interesting. The school is unusual in the fact that six of its classrooms are provided with small auxiliary work or classrooms for use by small groups of pupils in special or project problems. The individual classroom plan at this school shows what effect a variation in classroom method will have on a building plan. Besides the auditorium-gymnasium, with its locker and shower facilities arranged for community as well as school uses, the building provides an elementary shop for boys; a domestic arts room

General View



First Floor Second Floor

Peckham Vocational School, Buffalo

William B. Ittner and Ernest Crimi, Associated Architects

for girls, and a library-literature classroom. The school accommodates 600 pupils and was erected at a cost of $236,473, exclusive of equipment and architects' fees, or $395 per capita.

Secondary Schools

The Junior High School. This school includes the seventh, eighth and ninth grades. There is not a great difference in the planning of junior and senior high schools. The difference is really one of scope and emphasis. The health and recreational quarters of the junior school are not as extensive as in the senior. The laboratories are for general science only, while in the senior school they are specialized. As a rule, departmentalization is not as highly developed in the junior as in the senior school. With the advent of the enriched elementary school and the work-study-play plan of organization, the need for the segregated junior high school has materially diminished. A plan of combining the enriched elementary school with the junior high school has been carried out at Dayton, Ohio with signal success.

The Emerson School at Dayton, Ohio (page 311) was originally planned as an elementary school for 1,462 pupils and for the work-study-play or "platoon" organization. It was discovered, however, that by the addition of three special units the capacity of the school could be expanded to 1,640 and the junior grades could be included and given all the facilities called for by their courses of study. The units added were two general science laboratories and the commercial suite. The physical education, the library, the auditorium, the home economics and shop quarters had already been included in the plan. The Emerson School is a notable example of a building planned to a carefully prepared work-study-play schedule. Thoughtful educational planning on the part of the superintendent, coupled with skillful structural planning on the part of the architect, enabled the board to turn back $165,000 of the amount...

appropriated for the building. The plan is interesting from the point of pupil circulation and the location of the special quarters. Site peculiarities necessitated the location of the health quarters on one side of the building and the auditorium on the other, as the plot was long and narrow. The auditorium is arranged with separate entrances, and the stage is planned so that it can be used as a classroom. On the first floor may be noted the unit arrangement of the home economics, small gymnasium and play courts. On the second floor, the distribution of the classrooms and laboratories, the size and location of the library and special rooms are points of interest. The building cost complete was $498,000, exclusive of equipment and architects' fees, at a per pupil cost of $314. Many cities segregate the junior high school into separate buildings. At Jacksonville, Florida two segregated junior schools similar in plan and size have been erected.

Junior High Schools, Jacksonville,—two junior high schools,—recently completed, are representative of various ramifications of buildings of this type. In this case the buildings are three stories in height and are built around open patios. The corridors encircle each building, giving maximum circulation and egress. The auditoriums and gymnasiums find their places at either end of the buildings, convenient for the community use of the one and accessible to playgrounds for the other. The shops, all of generous sizes, are grouped upon the first floors, the study rooms and libraries on the intermediate floors, and laboratories for science and domestic arts, together with the cafeterias, are grouped upon the third floors. Each building accommodates 1,700 pupils and was erected complete, excluding equipment and architects' fees, for $555,000, at a per capita cost of $326.

Senior High School. These schools (grades 10, 11 and 12) represent what might be termed the last word in educational expansion. They cause the greatest per capita drain on the taxpayer, and the reasons are obvious. First of all, the sites must be large, owing to the athletic requirements. Next, it is scarcely possible to plan for definite class groups, owing to the large number of electives and collateral courses. Furthermore, the accessory units for all the various departments are most extensive. In some senior high schools the studies of the first two college years have been absorbed. The college course addition has no particular influence on the plan. Any well planned senior or four-year high school includes all the facilities required for junior college work.

The Senior High School-Junior College, Muskegon, Michigan (page 317) is one of a group of four buildings centrally located. An athletic field and stadium are adjacent to the school grounds. The outstanding features of this building are its auditorium-gymnasium stage and health quarters. The auditorium seats 1,300. With the steel curtain separating stage and gymnasium raised and the suspended bleachers dropped, additional seating capacity is provided for 500. The health quarters, located on the ground floor and readily accessible to the play field, consist of two examination rooms; two clinics; a dental room and two corrective gymnasiums. Together with locker and shower rooms for both boys and girls, the physical education facilities can care for 500 at a time. A supplementary auditorium for music and dramatics is located on the ground floor and in close proximity to the large auditorium. This room is unique in its plan and interior treatment. Two practice rooms and a band and orchestra room are also included in the ground floor plan. A cafeteria with 500 seatings flanks one side of the auditorium-gymnasium and is located under the court and top-lighted. It is supplemented by a faculty dining room, kitchen, kitchen store room and rooms for male and female kitchen attendants. Another feature unusual in schools is the museum. The cost of the building complete without equipment and architects' fees was $704,000,—a per capita cost of $454.

The High School, St. Petersburg, Florida is an outstanding example of planning for Southern climates. In a community of almost perpetual sunshine, the plan has been opened up to the fullest extent for natural ventilation. Provision for mechanical ventilation is conspicuous by its absence. The height is confined to two stories and is built around two open courts or patios upon which the corridors are entirely open as an arcade. Windows upon the inner wall above the blackboards permit of full cross ventilation to the classrooms. The school health activities, being conducted largely in the open, where ample playgrounds and an open air swimming pool are provided, permit the indoor health facilities to be reduced to a combination stage-gymnasium arrangement. Ample indoor locker and shower facilities are also provided. The building executed in the traditional Spanish is of tinted stucco trimmed with polychrome terra cotta. It accommodates 1,700 pupils and was erected complete without equipment and architects' fees for $426 per capita.

The Central Technical High School, Columbus, Ohio forms one of a group of buildings comprising the new civic center of Columbus. Being the first building to be erected, it was executed in monumental design in stone, serving to give the keynote for the buildings which are to follow. It occupies a commanding site on the west side of the Scioto River and is flanked on either side by monumental bridges. Its outstanding features comprise a music-lecture room facing two sunken gardens in the forecourt, the main entrance approach being across its roof. This brings the room into a location where it can be turned over for community uses without entrance to the school building proper. Another outstanding feature of the building is an auditorium to seat 1,500 with a double gymnasium-stage combination. The double combination includes a stage 20 feet deep separated from the girls' gymnasium by a steel soundproof curtain, the boys' gymnasium adjoining the other side to the rear. It is possible by this arrangement to throw the entire health suite together for

pageants, large choruses and the social features of the school. An art group comprising a room for drawing, a room for commercial art, printing, ceramics and art metal work, are grouped upon the uppermost story around an art gallery, all of which are top or gallery lighted. The cost of the building complete, without equipment and architects' fees, was $1,167,377. The pupil accommodation approximates 1,800, giving a per capita cost of $592.77.

The Bennett High School, Buffalo represents the full development of a comprehensive high school. Built to accommodate 2,500 pupils and occupying a commanding site, it comprises one of Buffalo's chief educational assets. The building is complete in the educational facilities it furnishes which include: 35 classrooms for academic classes; a group of eight domestic arts rooms; four art rooms; eight science laboratories; ten study rooms; two gymnasiums, a swimming pool; an auditorium seating 2,000, and a supplementary auditorium or music-lecture room, separate cafeterias for boys and girls, each seating 500, and a faculty dining room, seating 70, all served from a common kitchen. The building cost $1,500,000 without equipment and fees, or $600 per capita.

The Vocational High School

Present-day high school planning tends toward the incorporation of vocational activities in junior and senior high schools, rather than toward a segregation of trade courses in separate vocational buildings. By providing vocational courses in high schools, all students have the advantage of shop activities close at hand, and those who desire to pursue any certain type of trade may devote to it some school time and all leisure time. In cities that are highly industrial, however, a centralized vocational school is erected in addition to the vocational departments in the high schools. In such schools vocational activities are pursued as trade courses. The plans for a vocational building as a rule make limited provision for the academic or strictly educational quarters of the building, as the students attend other schools of the city, coming to the vocational school only for intensive training in vocational courses.

In the Peckham Vocational School, Buffalo the academic features of the building are confined to a two-story structure containing a limited number of classrooms and laboratories, a combination auditorium-gymnasium and a cafeteria. The remainder of the school consists of large, undivided, top-lighted areas capable of being split up into vocational units as the varying requirements demand. The building was erected complete at a cost of $462,129, exclusive of equipment and architects' fees.

The Complete School. A concentration of all grades in one school represents a departure from the usual in school building policies. Several small cities have adopted this plan. The arguments presented by the advocates of this plan are:

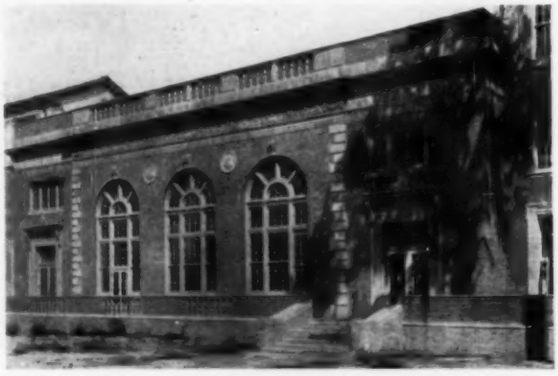
1. There is no convenient dropping-out place.
2. The enriched facilities of the high school are available for the younger children when not in use by high school students.
3. The situation is more natural when older and younger students are in personal contact with one another a part of the school day, as, for instance, during recreation and some of the more informal periods of special activities.

The Complete School at Longview, Washington, the home of the Long-Bell Lumber Co., is the gift of R. A. Long, president of the company. This school is planned for 2,800 pupils and includes all grades from kindergarten through the high school. The three building units, the elementary, the junior and the senior high, are located on a 39-acre site. As Longview is in the strictest sense an American city, Colonial architecture was chosen. The center building, the senior high school, houses the school and community auditorium with its capacity for 1,000. Directly behind the auditorium, across the corridor, is the double gymnasium divided by sliding door walls. There is a very definite relationship between the gymnasium and the cafeteria (38 x 164 feet). Although separated by a small court, both units are readily accessible to the public.

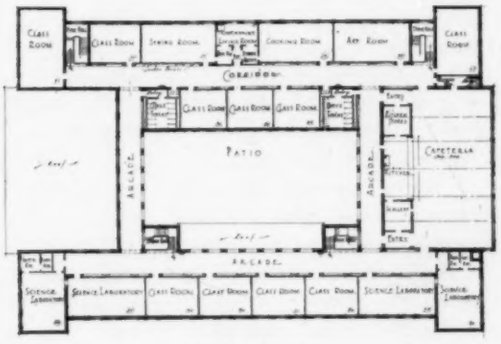
The two wings that connect the center senior unit with the elementary and junior schools are part of the senior school and house the vocational and home economics departments. The library-study on the second floor runs across the front and commands a view of the landscaping below. It is an unusual room, 24 x 140 feet, with a capacity of 200 students. Most of the classrooms are distributed on this floor. The junior high school also contains a double gymnasium with complete accessories. There are no shops or home economics rooms in the junior unit, since those provided in the senior high school will serve all students. The library-study overlooks the grounds and has a capacity for 70 students. The art room, 20 x 45 feet, is centrally located on the second floor. A feature of the elementary school is the covered play court in place of a gymnasium. The climate at Longview permits of almost continuous out-of-door play. The kindergarten is planned with a bay and with its own outside entrance. A music room with a small stage is provided, so that it can also serve as an auditorium for smaller groups. The two large classrooms on the second floor are the nature study and handwork rooms.

Summary. As educational programs and methods of school procedure are variable factors in school communities, and as building policies, climate and site conditions are also variable, every school building becomes an individual problem. Rules and formulæ can and have been evolved as guides to safety, lighting and sanitation of schools. The real test of the success of a school building, however, is its working efficiency. Therefore, an intimate relationship must exist between the educational plan and the building plan. If a school building renders maximum educational service, the mechanical elements will exist as natural accompaniments.

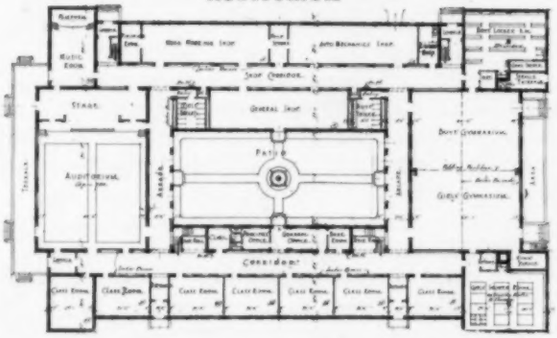
GENERAL VIEW



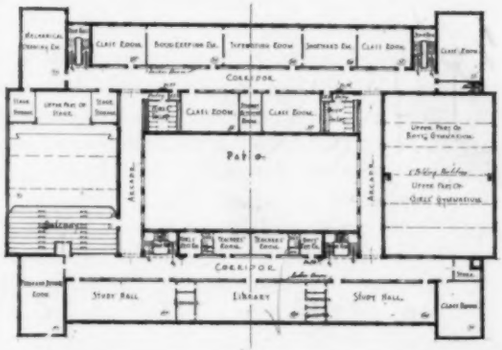
AUDITORIUM



THIRD FLOOR



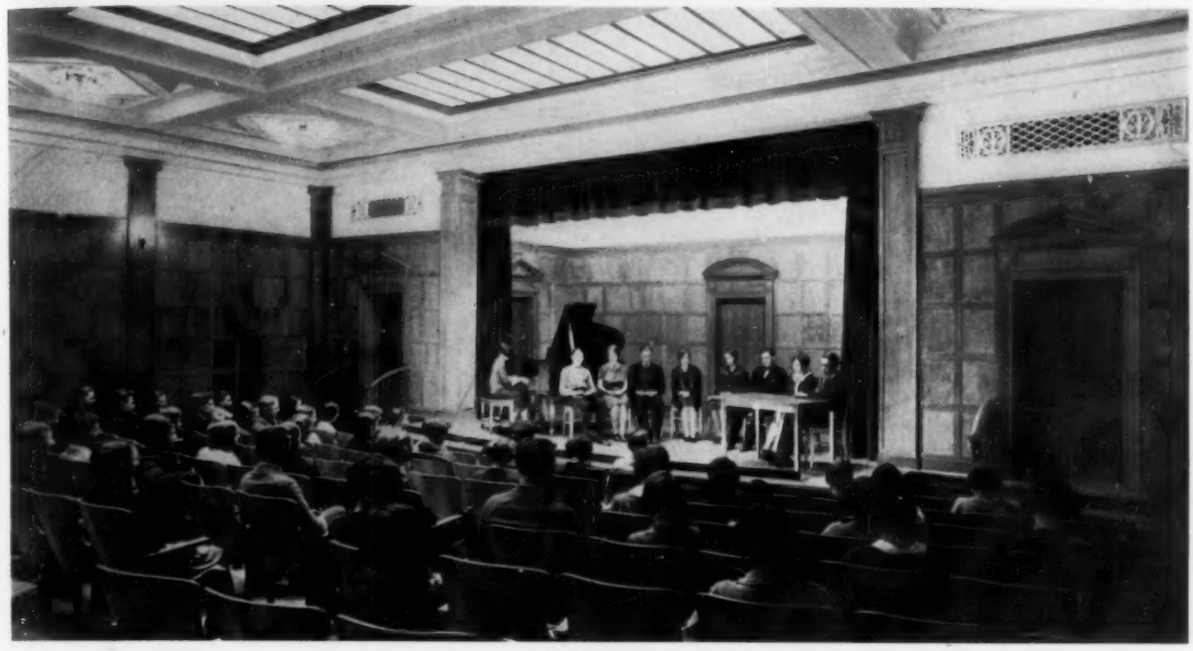
FIRST FLOOR



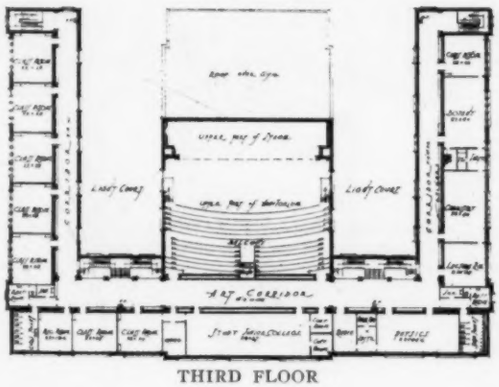
SECOND FLOOR

ROBERT E. LEE SENIOR HIGH SCHOOL, JACKSONVILLE, FLA.

MARK & SHEFTALL, ARCHITECTS; WILLIAM B. ITTNER, CONSULTING ARCHITECT



MUSIC EXPRESSION ROOM



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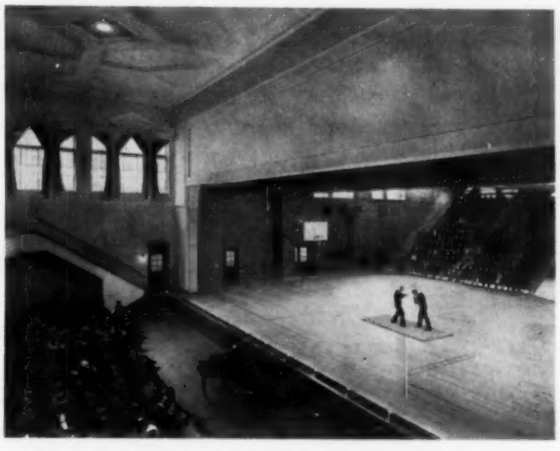
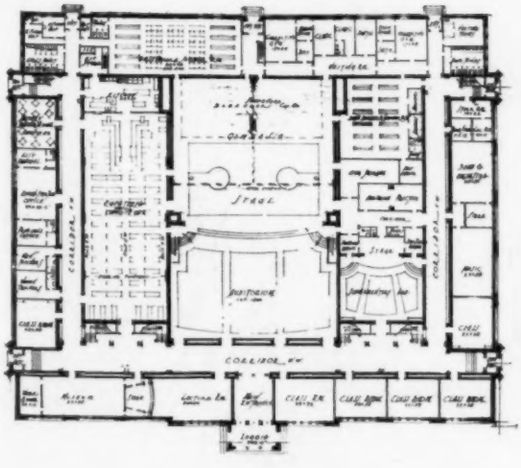


AUDITORIUM AND STAGE GYMNASIUM



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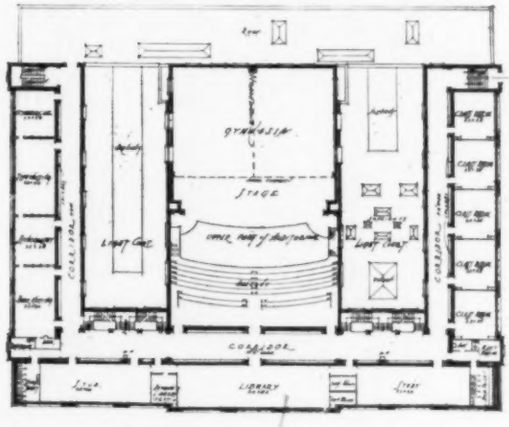
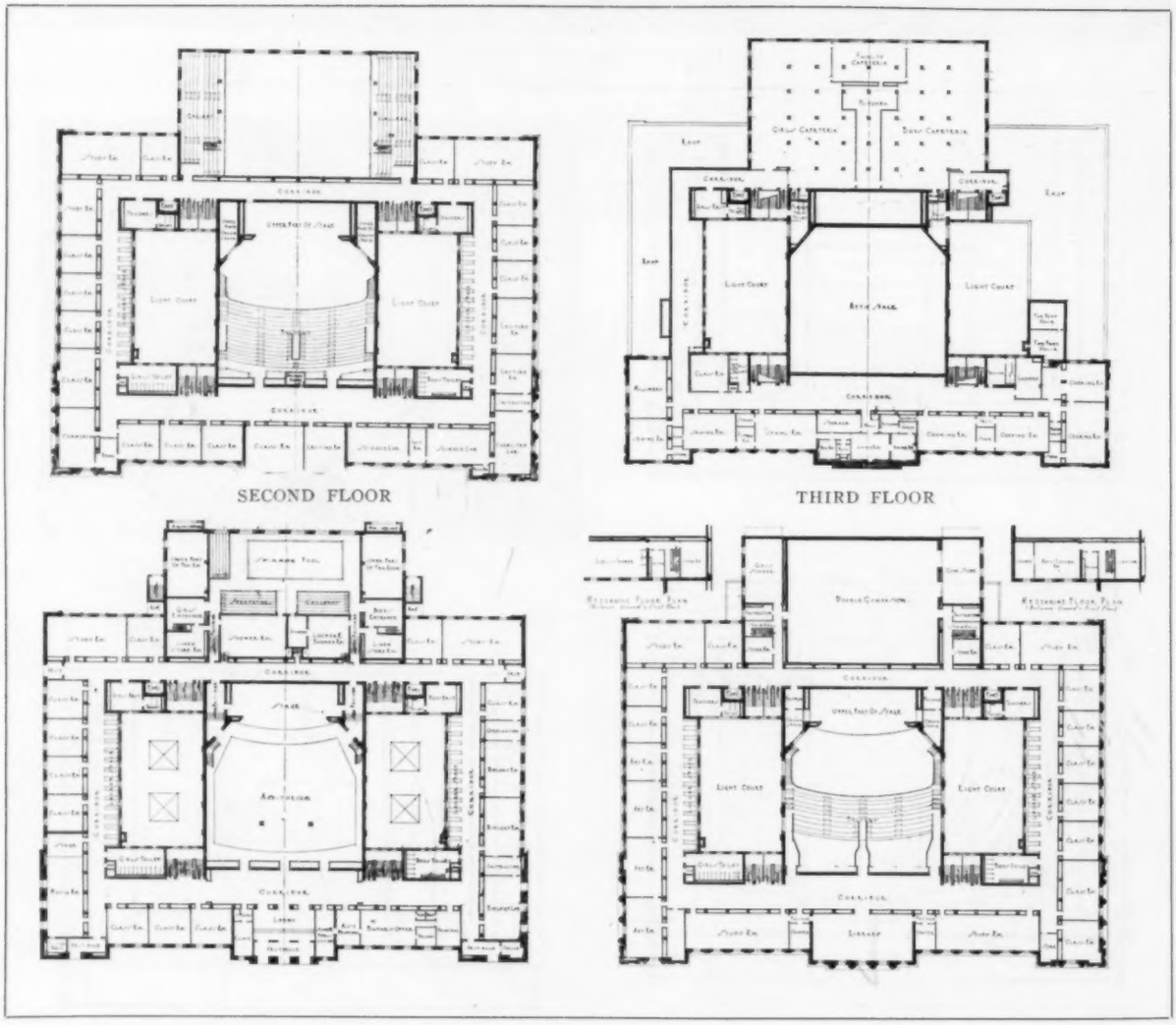


SECOND FLOOR

SENIOR HIGH SCHOOL—JUNIOR COLLEGE, MUSKEGON, MICH.

WILLIAM B. ITTNER, ARCHITECT

GENERAL VIEW



SECOND FLOOR

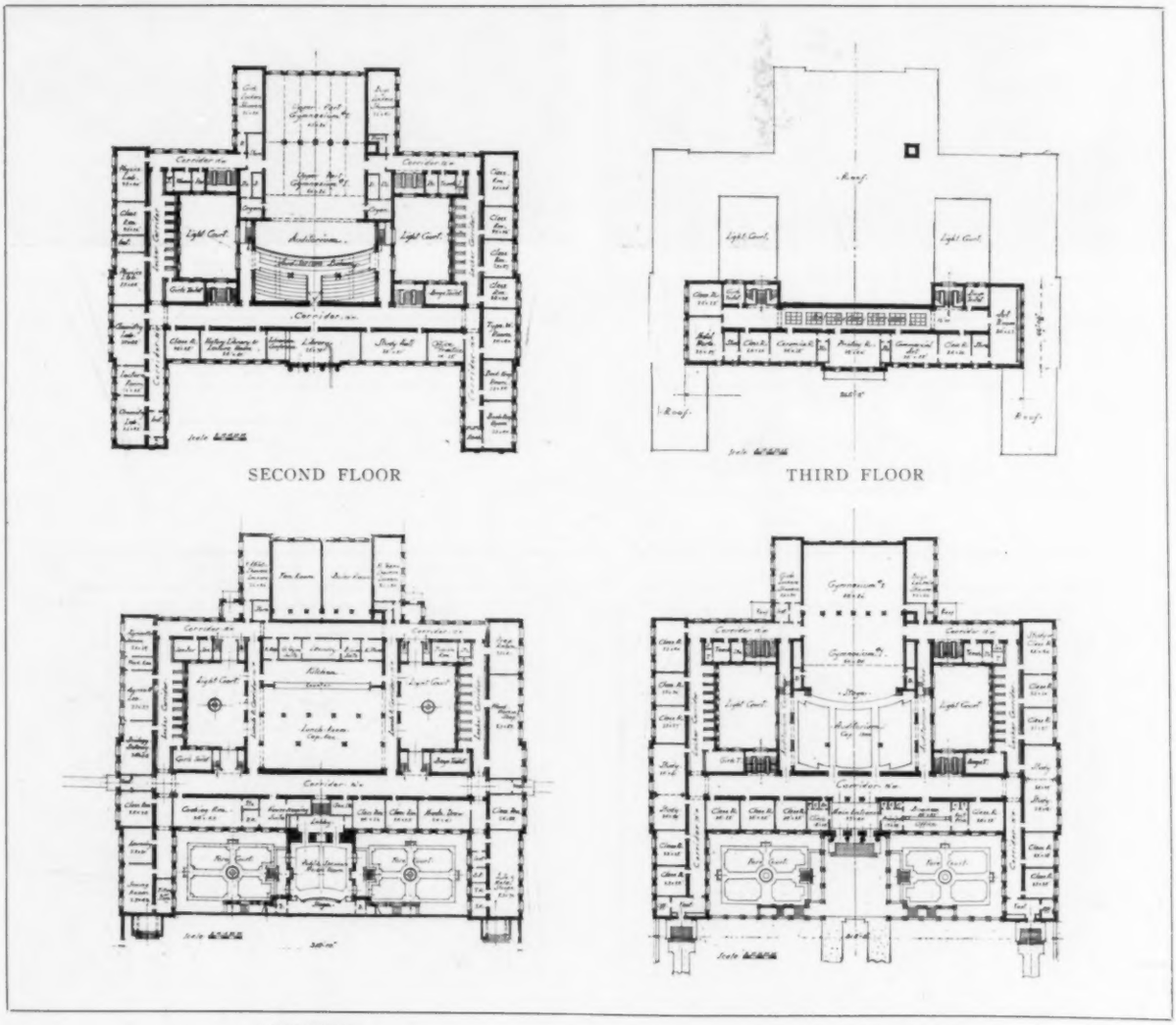
THIRD FLOOR

BASEMENT

FIRST FLOOR

BENNETT HIGH SCHOOL, BUFFALO

WILLIAM B. ITTNER, ASSOCIATED BUFFALO ARCHITECTS, ERNEST CRIMI, ASSOCIATED ARCHITECTS



SECOND FLOOR

THIRD FLOOR

BASEMENT

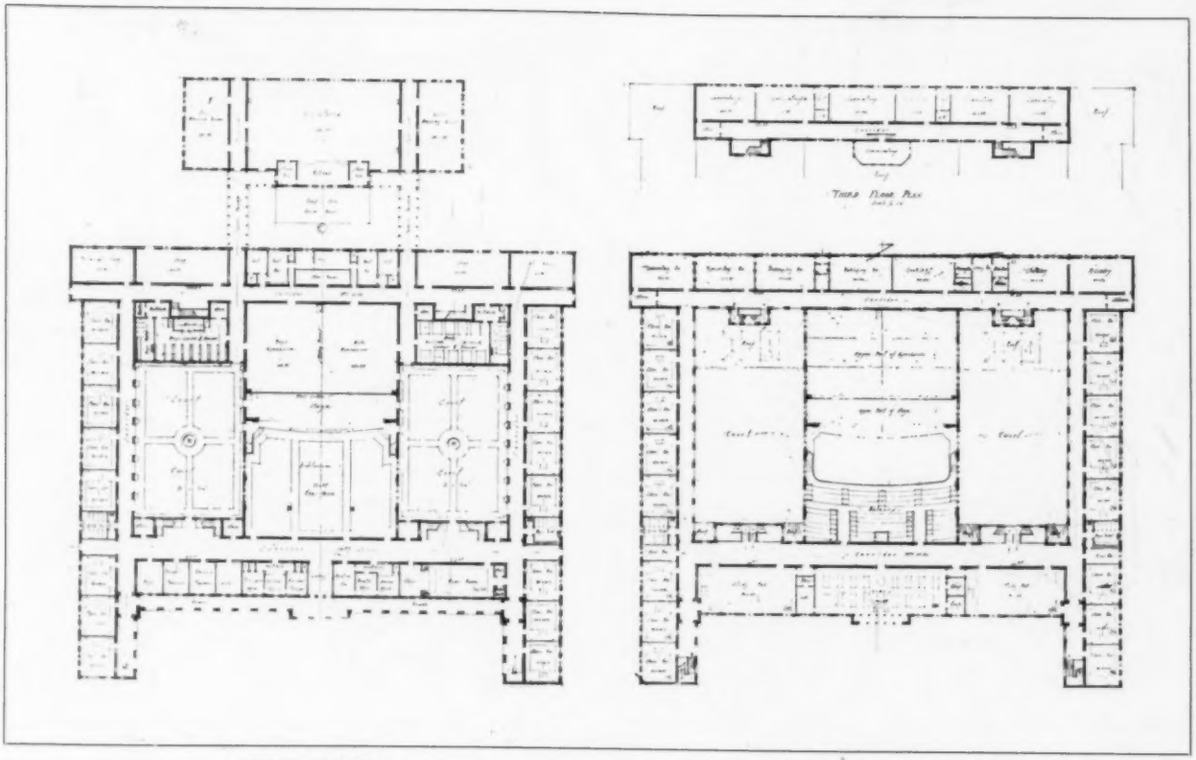
FIRST FLOOR

CENTRAL TECHNICAL HIGH SCHOOL, COLUMBUS, O.

WILLIAM B. ITTNER, ARCHITECT

MAIN ENTRANCE

INTERIOR COURT

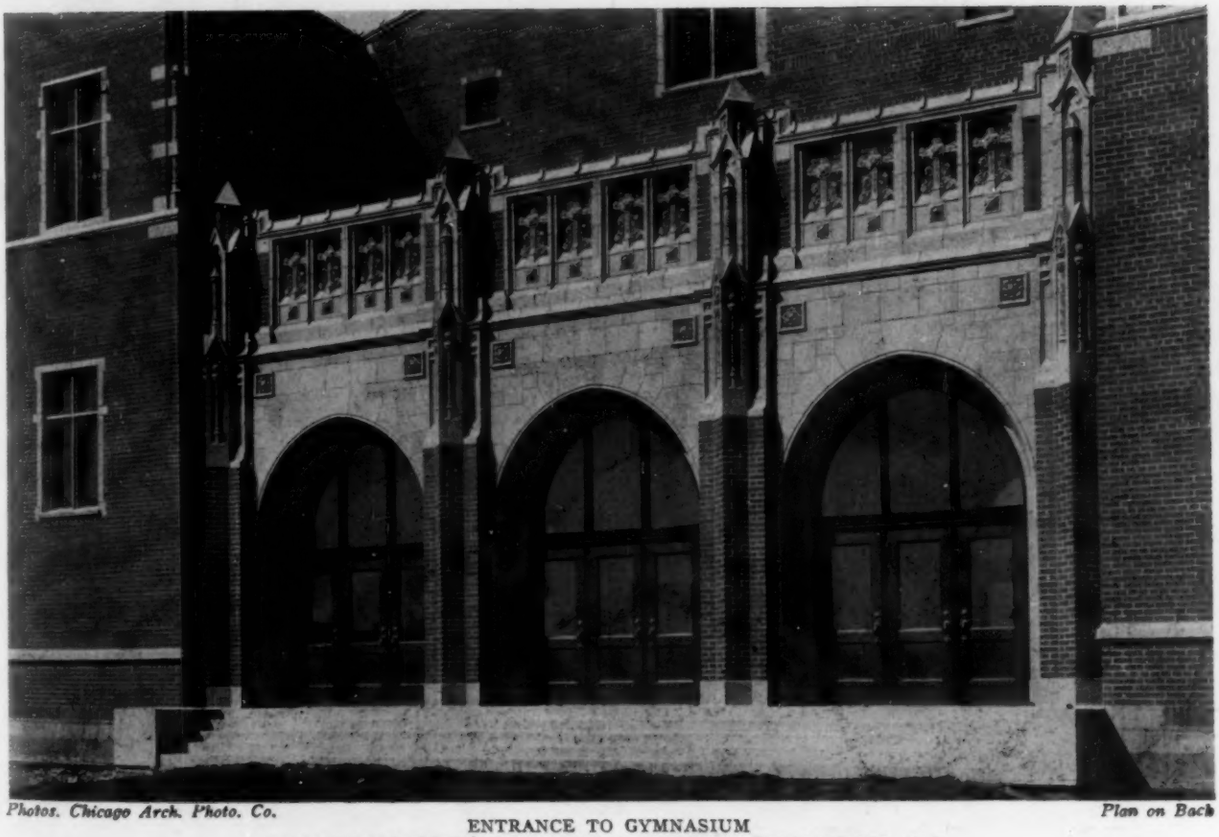


FIRST FLOOR SECOND FLOOR

ST. PETERSBURG HIGH SCHOOL, ST PETERSBURG, FLA.

WILLIAM B. ITTNER AND M. LEO ELLIOTT, ASSOCIATED ARCHITECTS

FRONT ELEVATION



Photos. Chicago Arch. Photo. Co. *Plan on Back*

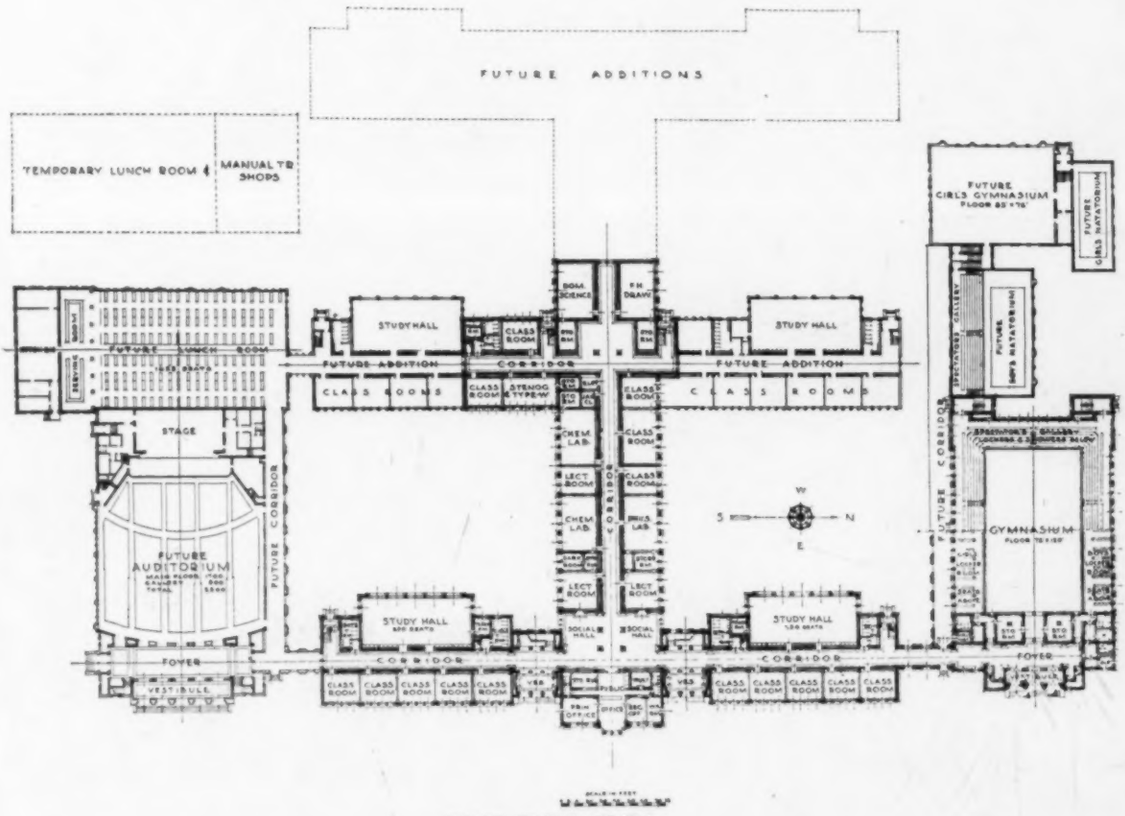
ENTRANCE TO GYMNASIUM

EVANSTON TOWNSHIP HIGH SCHOOL, EVANSTON, ILL.

PERKINS, FELLOWS & HAMILTON AND HAMILTON, FELLOWS & WILKINSON, ARCHITECTS

COST AND CONSTRUCTION DATA

Designed to eventually accommodate 4,000 or more pupils, only a portion of the academic building and the main gymnasium wing have been built as yet. The cost of these units including the power house and the temporary lunch room and manual training shops was approximately $1,800,000, which on the basis of 1,800 pupils now enrolled makes a cost of about $1,000 per pupil. The unit cost of both the academic and gymnasium sections with the cost of separate heating plant apportioned to them was 37.1 cents per cubic foot. The exterior treatment is brick trimmed with terra cotta, and the general construction is fireproof.



FIRST FLOOR PLAN

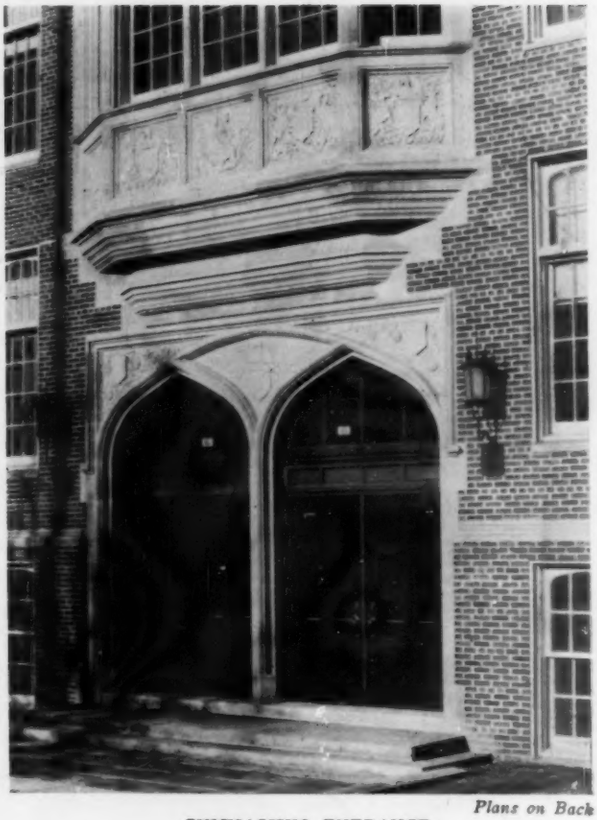
EVANSTON TOWNSHIP HIGH SCHOOL, EVANSTON, ILL.

PERKINS, FELLOWS & HAMILTON AND HAMILTON, FELLOWS & WILKINSON, ARCHITECTS

MAIN ELEVATION

Photos. Swain

AUDITORIUM



Plans on Back

GYMNASIUM ENTRANCE

JACKSON HIGH SCHOOL, JACKSON, MICH.

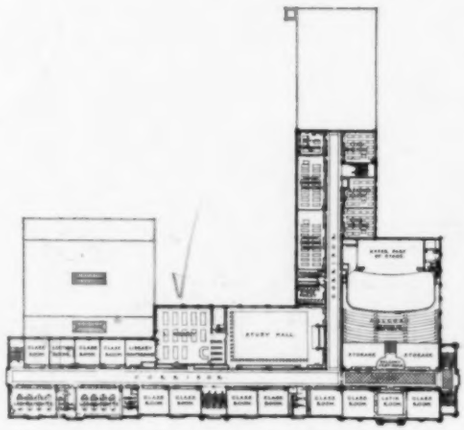
CHILDS & SMITH, ARCHITECTS

UNIV. OF MICH.

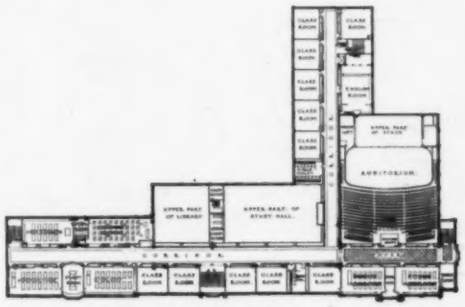
COST AND CONSTRUCTION DATA

Completed September 1927, this school has a capacity of 2,000 pupils and was built at a cost of $1,130,000 or 33 cents per cubic foot. The cost per pupil is approximately $565.

It is fireproof in construction, and the exterior finish is brick with cut stone trim. The roofs are covered with tar and gravel composition.



SECOND FLOOR



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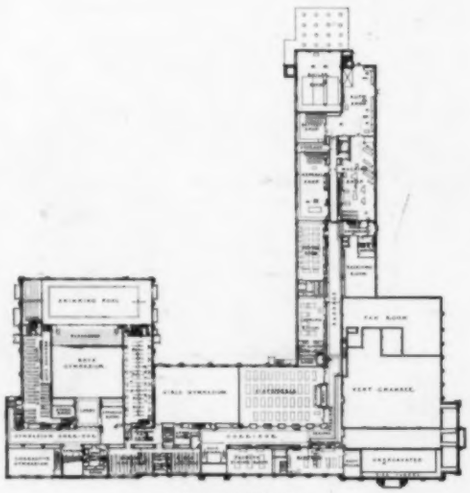
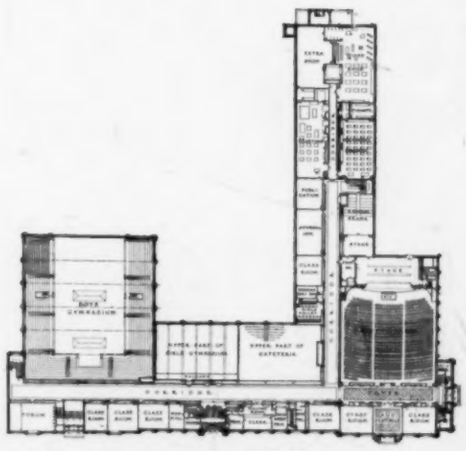


BASEMENT

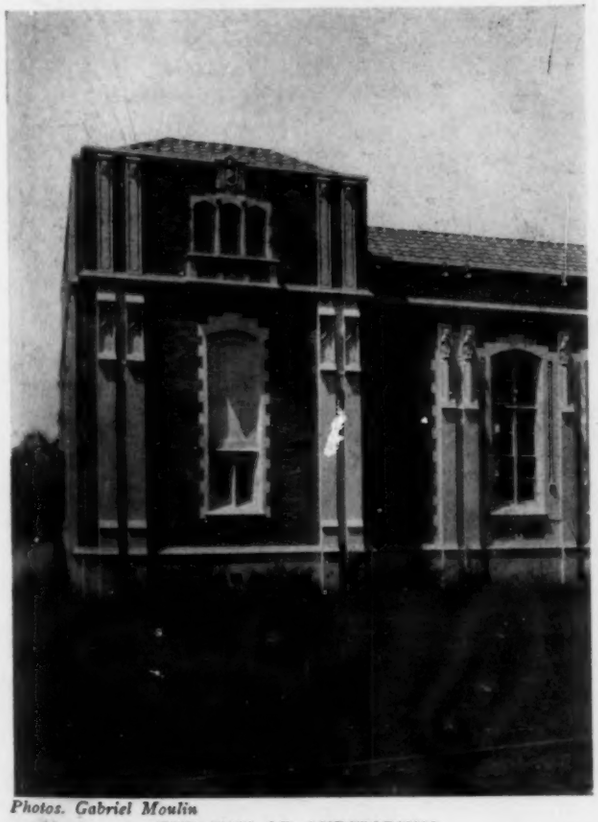


FIRST FLOOR

PLANS, JACKSON HIGH SCHOOL, JACKSON, MICH.

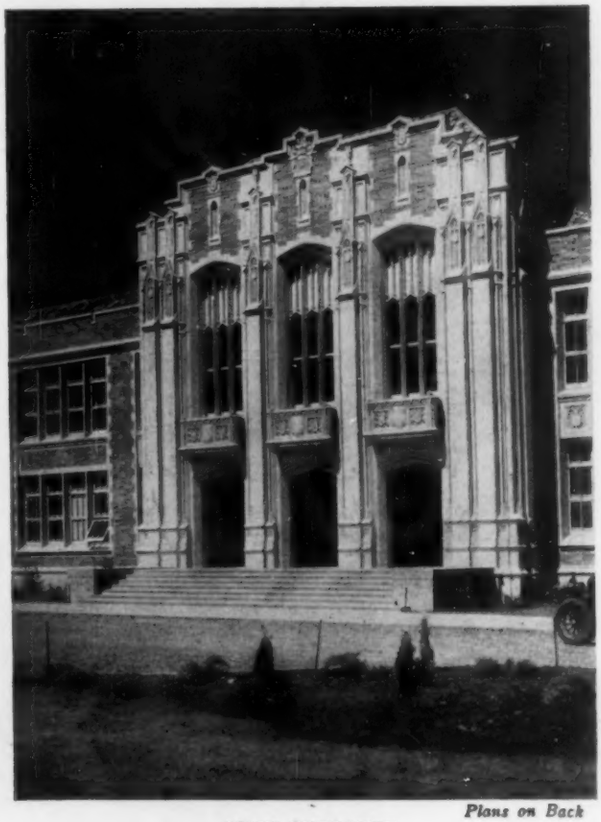
CHILDS & SMITH, ARCHITECTS

GENERAL VIEW



Photos. Gabriel Moulin

END BAY OF AUDITORIUM



Plans on Back

MAIN ENTRANCE

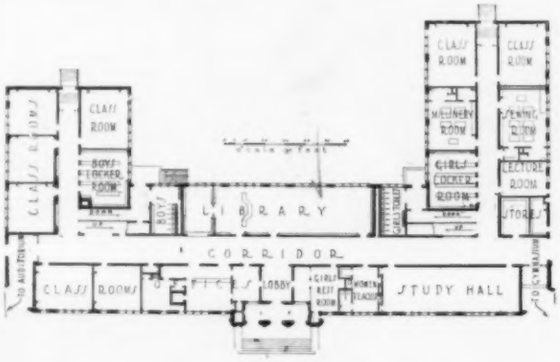
SANTA ROSA HIGH SCHOOL, SANTA ROSA, CAL.

W. H. WEEKS, ARCHITECT

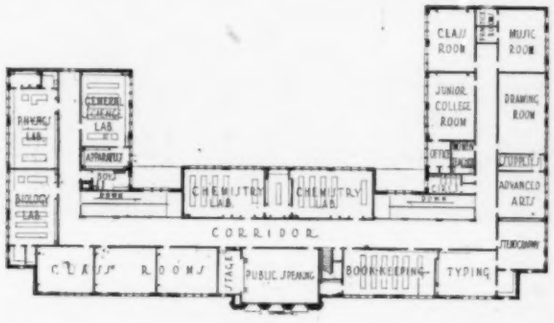
COST AND CONSTRUCTION DATA

Having a capacity of a thousand pupils, this school was completed in 1925 at a cost of $368,305 or 24 cents per cubic foot, making a unit cost of about $368 per pupil. The cost of equipment used in this building was $40,000.

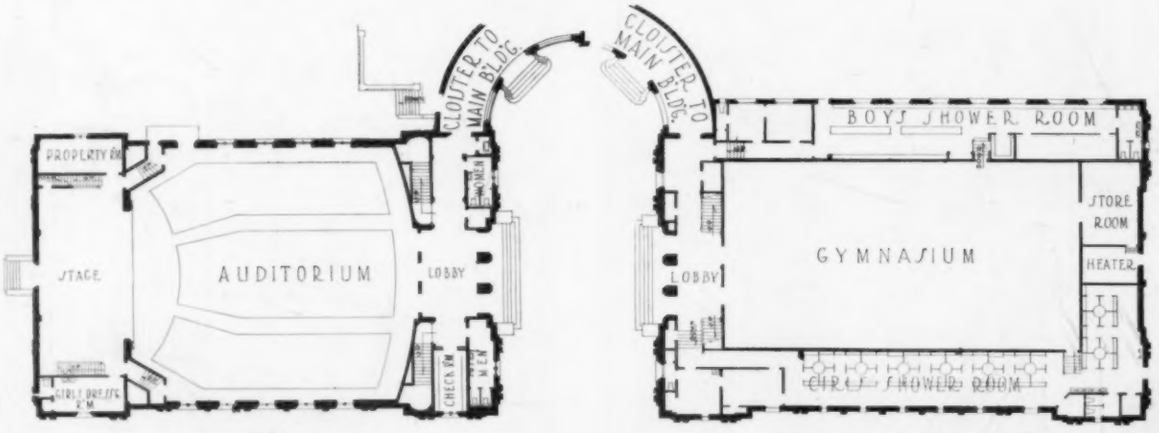
Pressed brick in variegated shades trimmed with cast stone and terra cotta are used for the exterior finish, while the roof covering is of terra cotta tile. The general construction is fireproof.



FIRST FLOOR



SECOND FLOOR



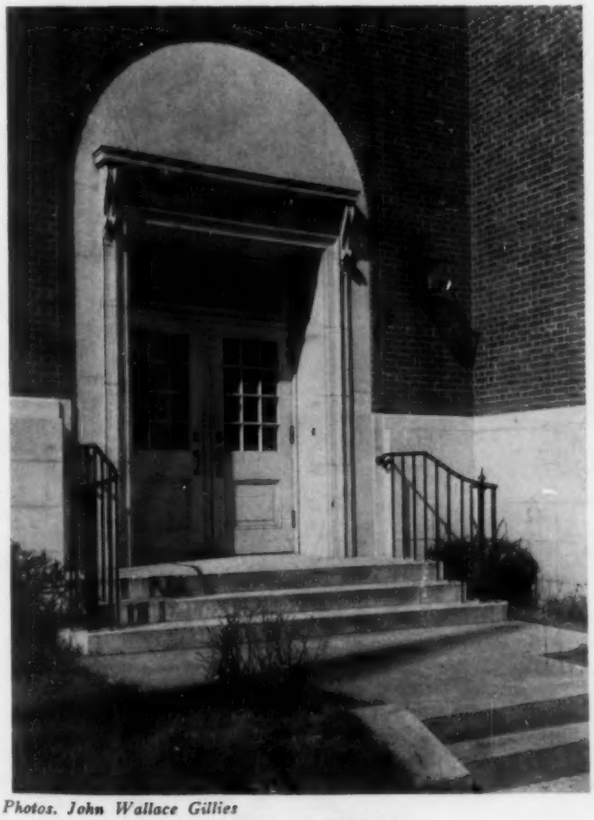
AUDITORIUM WING

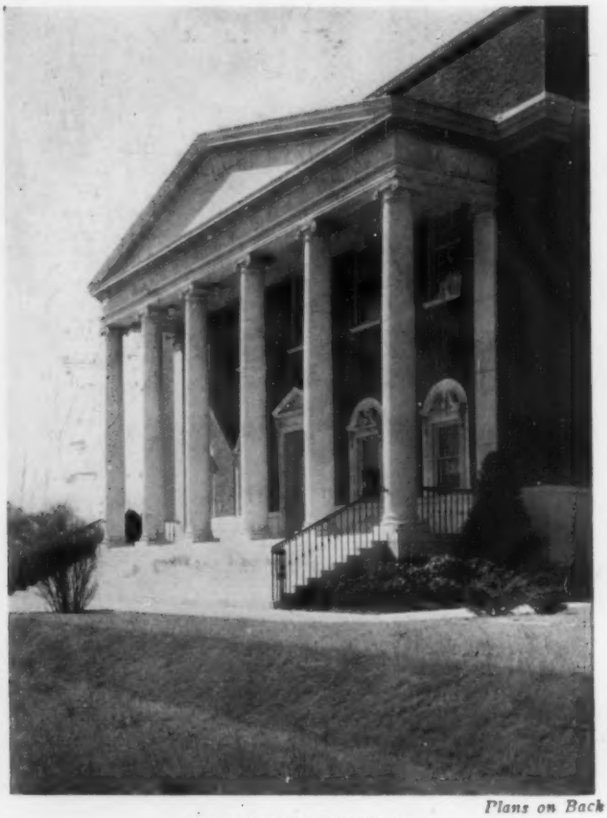
GYMNASIUM WING

PLANS, SANTA ROSA HIGH SCHOOL, SANTA ROSA, CAL.

W. H. WEEKS, ARCHITECT

GENERAL VIEW





Photos. John Wallace Gillies *Plans on Back*

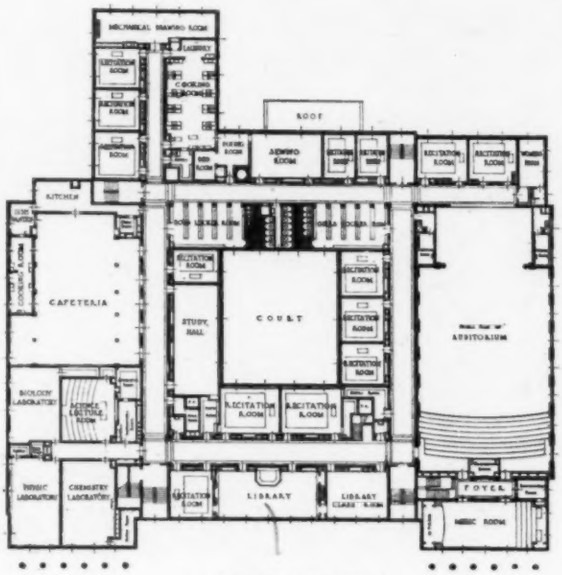
CORRIDOR ENTRANCE GYMNASIUM ENTRANCE

ORANGE HIGH SCHOOL, ORANGE, N. J.

ERNEST SIBLEY AND LAWRENCE C. LICHT, ARCHITECTS

COST AND CONSTRUCTION DATA

The capacity of this school is 965 pupils, and it was completed in 1925 for $781,000 or 41.4 cents per cubic foot.



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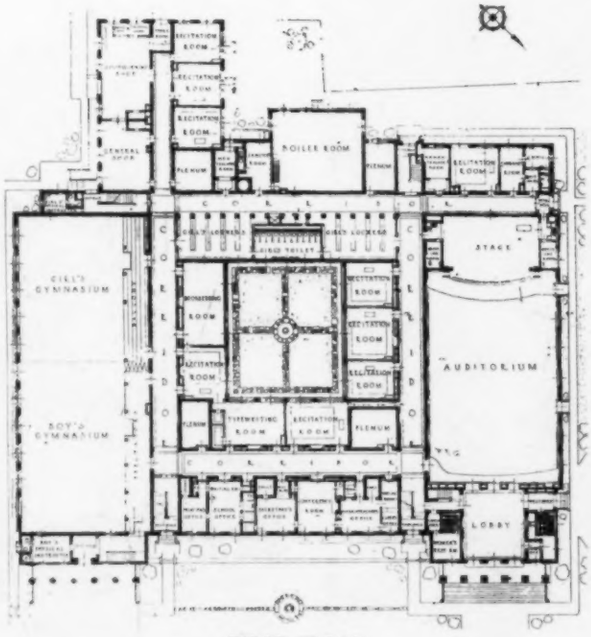
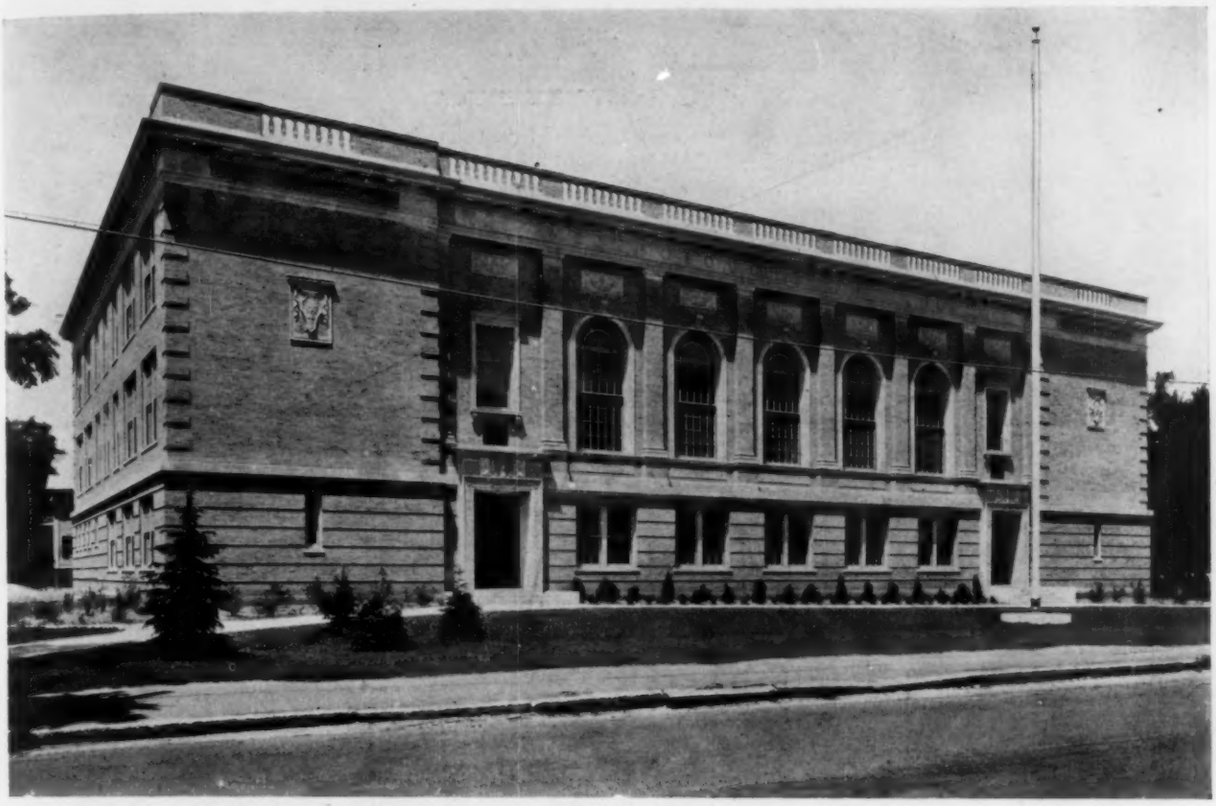


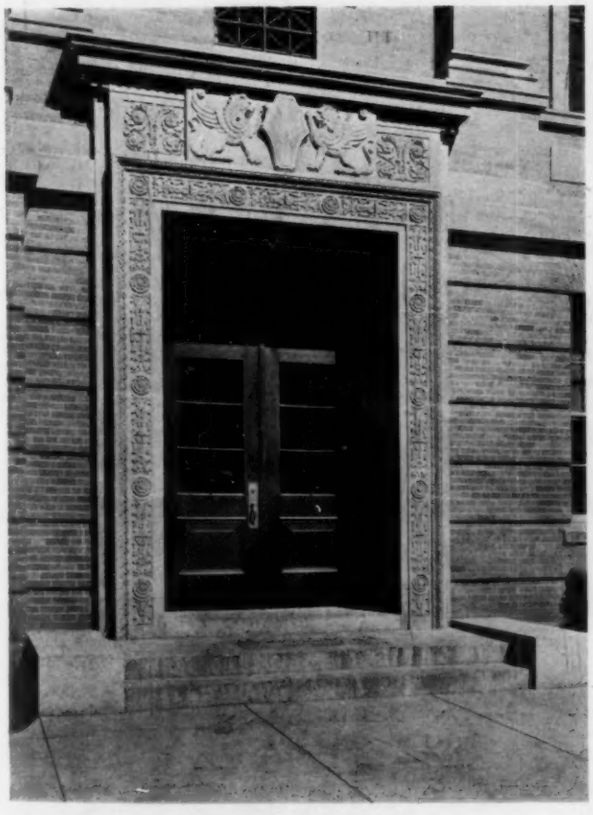
FIRST FLOOR

PLANS, ORANGE HIGH SCHOOL, ORANGE, N. J.

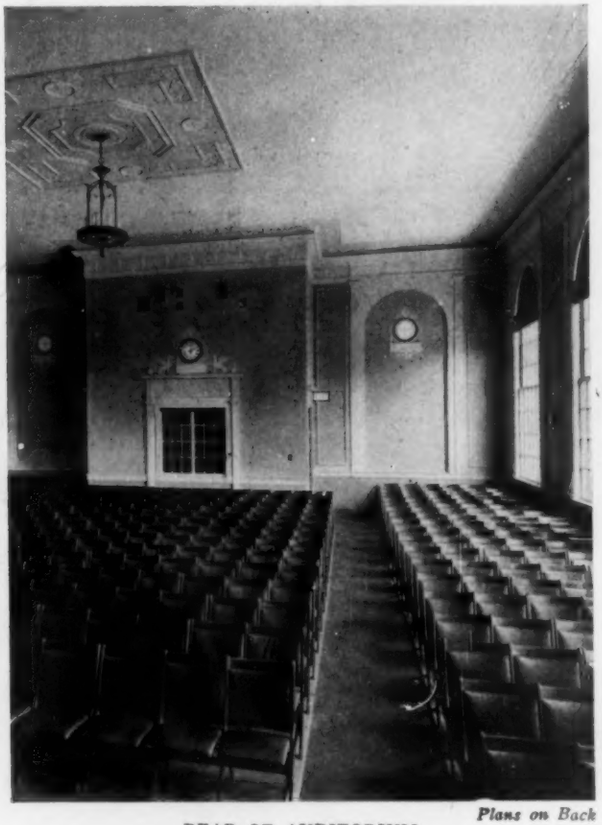
ERNEST SIBLEY AND LAWRENCE C. LICHT, ARCHITECTS



GENERAL VIEW



ENTRANCE DOOR



REAR OF AUDITORIUM

Plans on Back

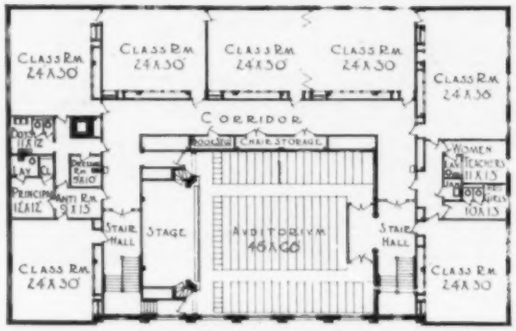
WESTBORO HIGH SCHOOL, WESTBORO, MASS.

JAMES H. RITCHIE & ASSOCIATES, ARCHITECTS

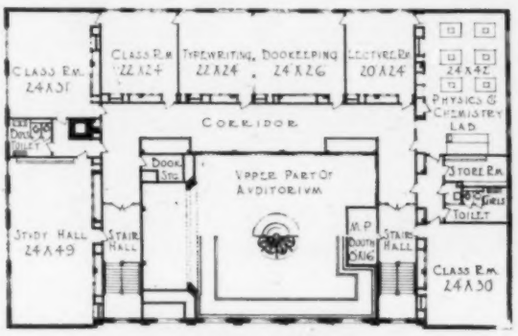
COST AND CONSTRUCTION DATA

Work on this school was completed on May 22, 1926. The total cost was $264,000 or 39.6 cents per cubic foot. It is designed to accommodate 500 pupils, making the cost per pupil $528. The equipment cost was $16,800.

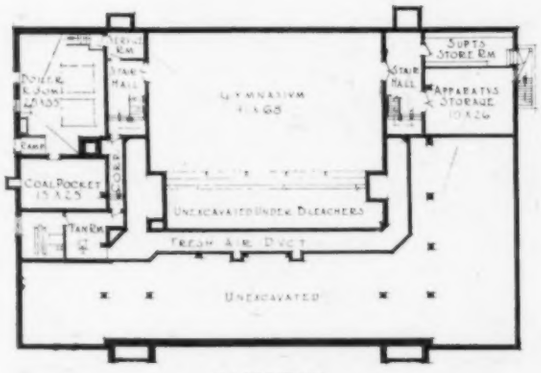
It is built in the Georgian style of light colored brick with limestone trim. The roofs are covered with tar and gravel.



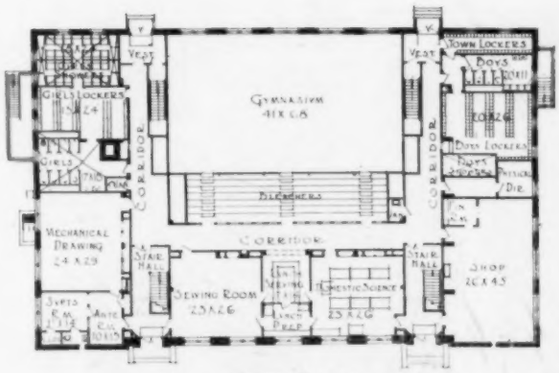
SECOND FLOOR



THIRD FLOOR



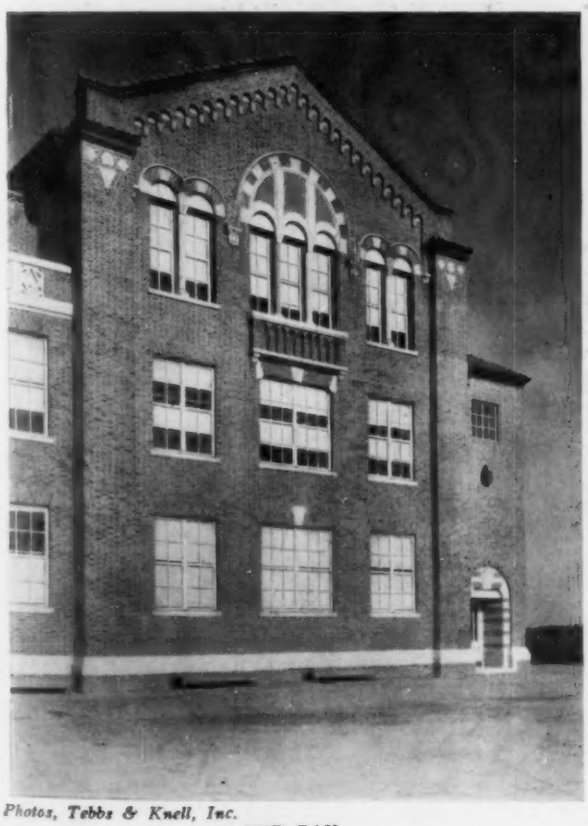
BASEMENT



FIRST FLOOR

PLANS, WESTBORO HIGH SCHOOL, WESTBORO, MASS.
JAMES H. RITCHIE & ASSOCIATES, ARCHITECTS

GENERAL VIEW



Photos, Tebbs & Knell, Inc. *Plans on Back*

END BAY MAIN ENTRANCE

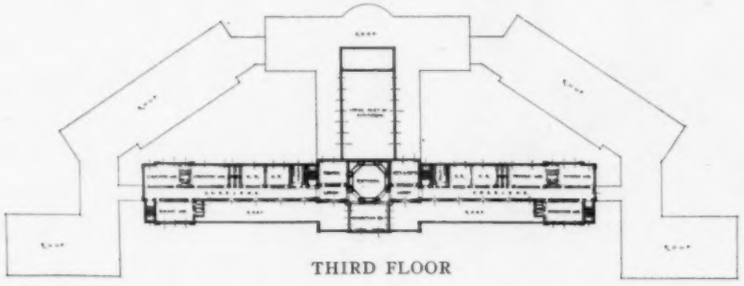
GIRLS' SENIOR HIGH SCHOOL, ATLANTA

EDWARDS & SAYWARD, ARCHITECTS

COST AND CONSTRUCTION DATA

The first or central unit of this building was completed in January, 1926 at a total cost of $500,000 or 40 cents per cubic foot. Its capacity is 1,300 pupils, making the cost per pupil about $384. Equipment costing approximately $45,000 has been installed in the building.

The general construction is fireproof.



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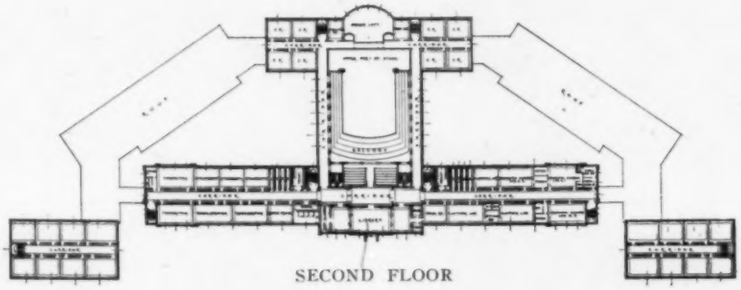

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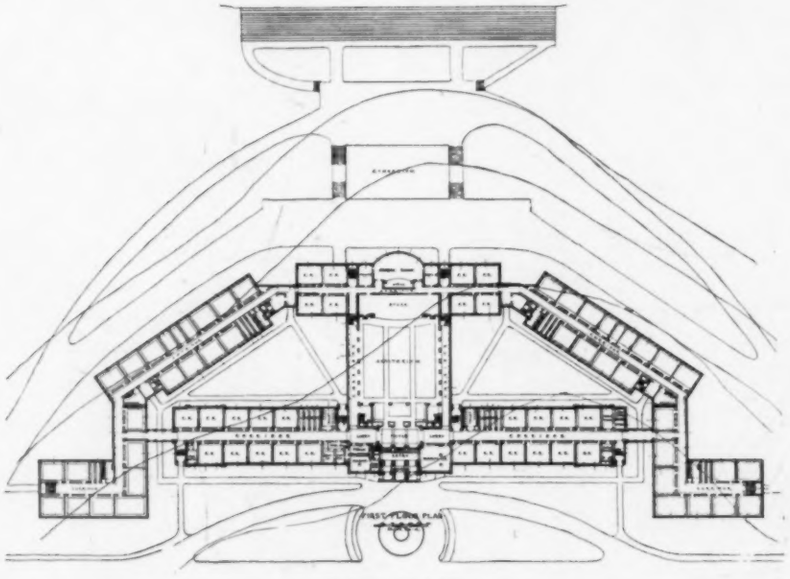
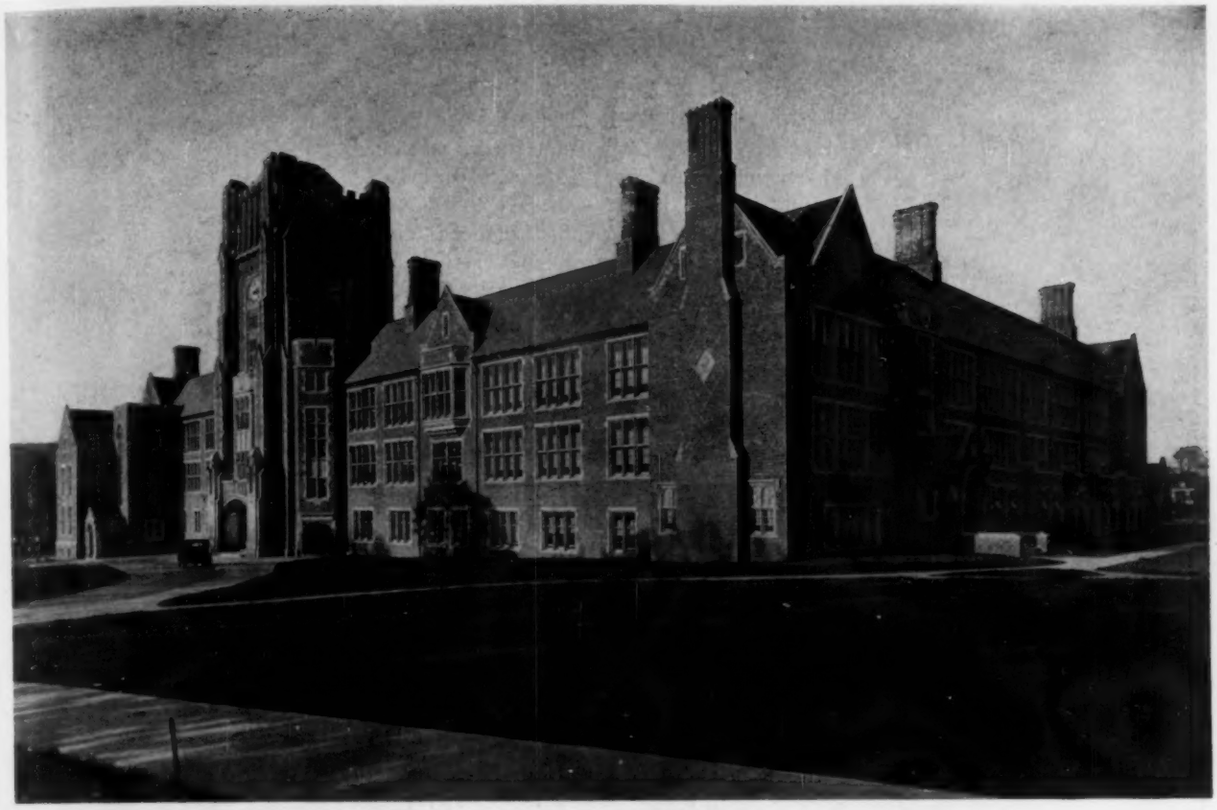


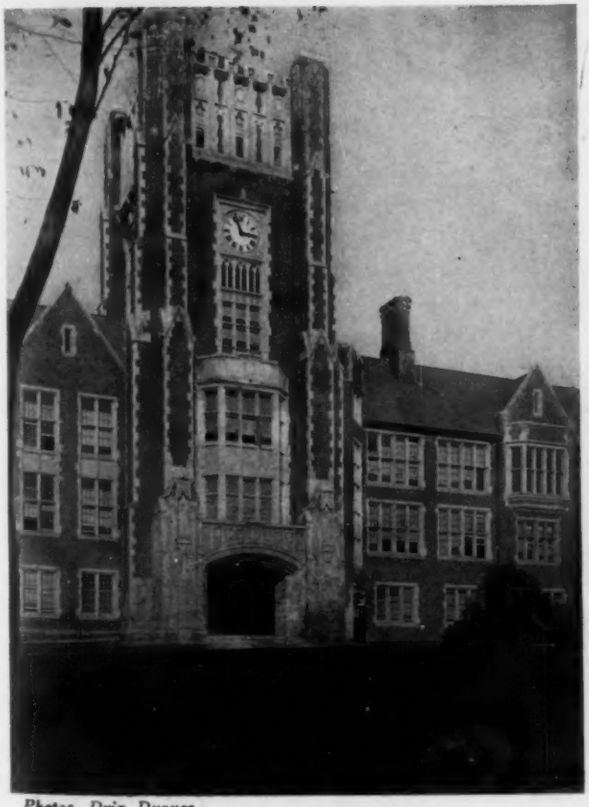
FIRST FLOOR

PLANS, GIRLS' SENIOR HIGH SCHOOL, ATLANTA

EDWARDS & SAYWARD, ARCHITECTS

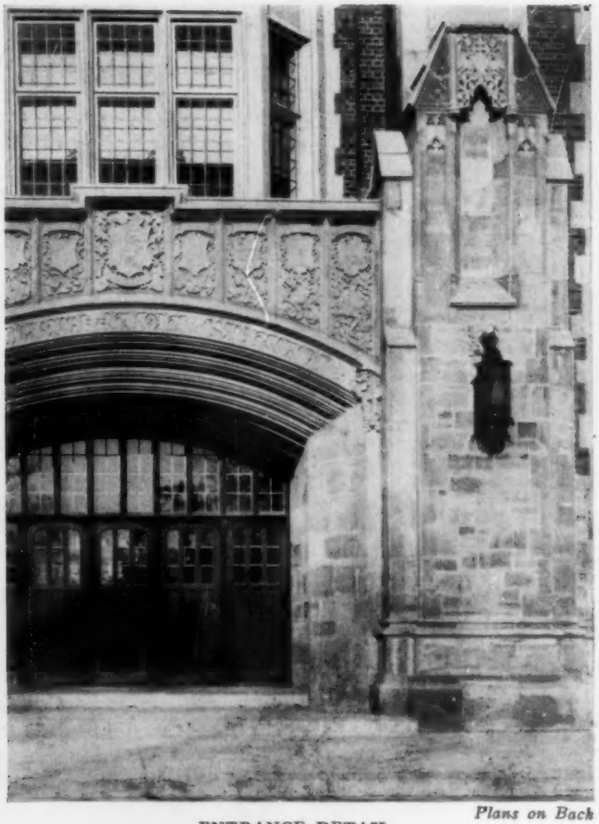


GENERAL VIEW



Photos. Drix Duryea

CENTER TOWER



ENTRANCE DETAIL

Plans on Back

COLUMBIA HIGH SCHOOL, SOUTH ORANGE, N. J.

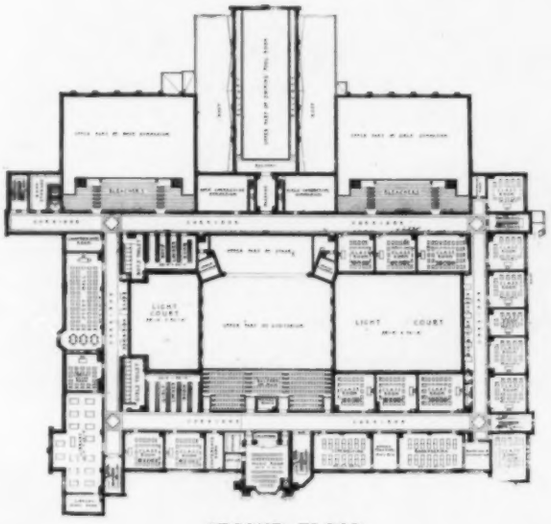
GUILBERT & BETELLE, ARCHITECTS

UNIV. OF MICH.

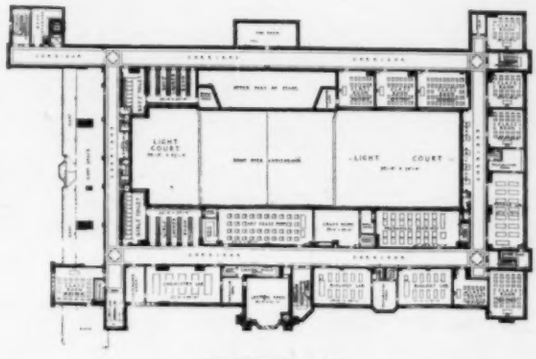
COST AND CONSTRUCTION DATA

Completed in September, 1927 at a total cost of $1,493,105 or 52 cents per cubic foot, this building has a capacity of 1,630 pupils, making it cost about $916 per pupil.

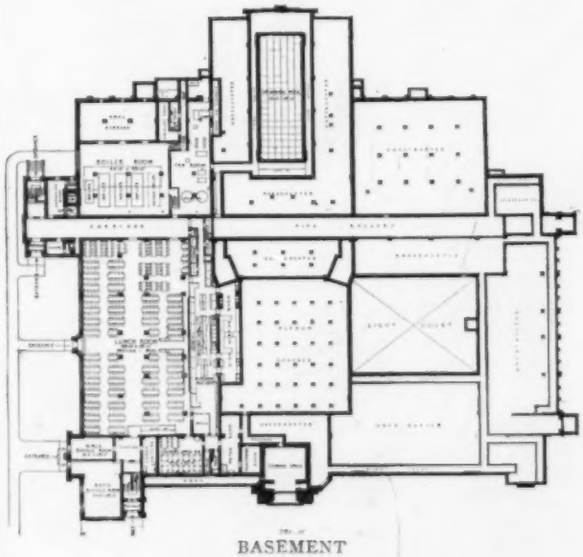
Slate is used for sloping roofs, and pitch and slag composition on the flat roofs. The exterior walls are of brick trimmed with limestone, and the general construction is fireproof.



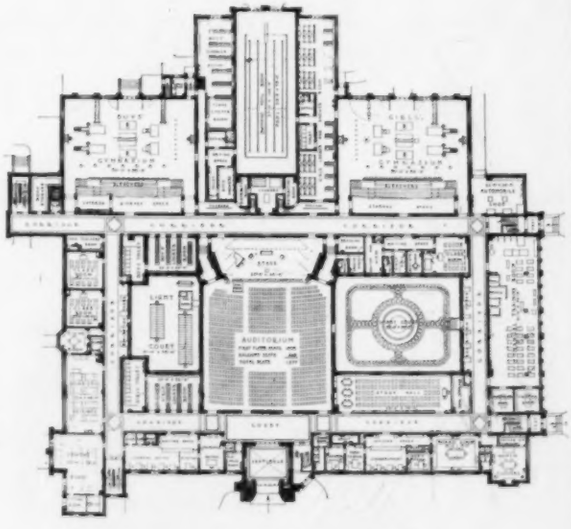
SECOND FLOOR



THIRD FLOOR

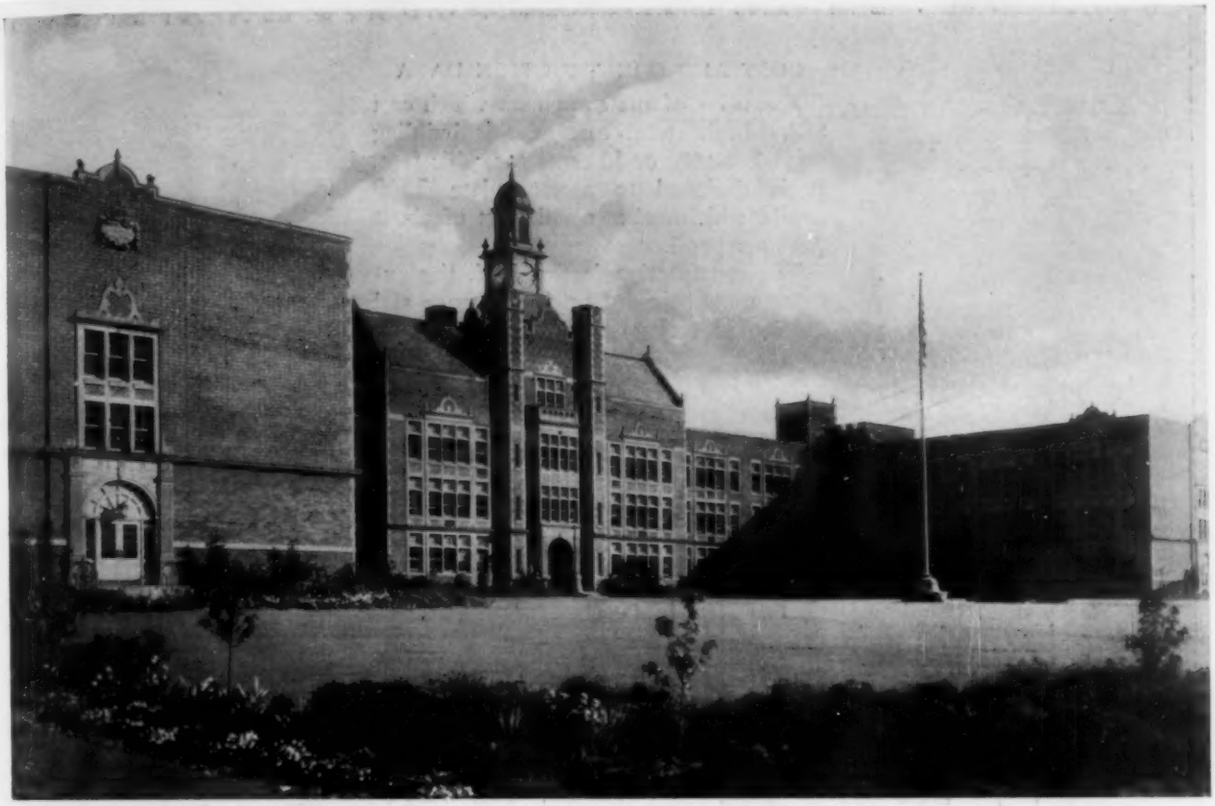


BASEMENT



FIRST FLOOR

PLANS, COLUMBIA HIGH SCHOOL, SOUTH ORANGE, N. J.
GUILBERT & BETELLE, ARCHITECTS



GENERAL VIEW

ENTRANCE TO WEST WING

SIDE ENTRANCE

Photos. White

Plans on Back

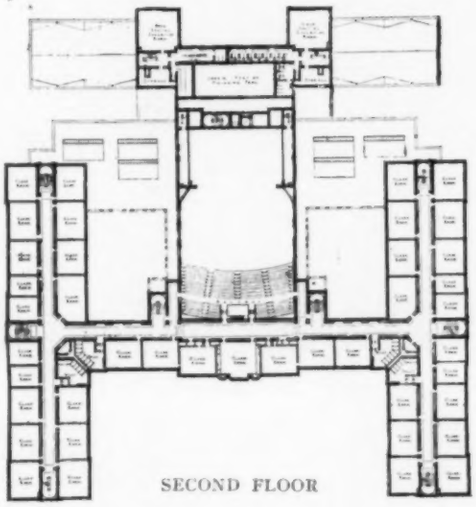
CLEVELAND HEIGHTS HIGH SCHOOL, CLEVELAND

WARNER, McCORNACK & MITCHELL, ARCHITECTS

COST AND CONSTRUCTION DATA

Exclusive of the equipment which cost $82,913, the total cost of this building was $1,430,685 or 53 cents per cubic foot. It is designed to accommodate 2,100 pupils, which makes a unit cost of about $681 per pupil.

The construction is fireproof, the exterior walls being of brick and stone and the roof covering slate and composition.



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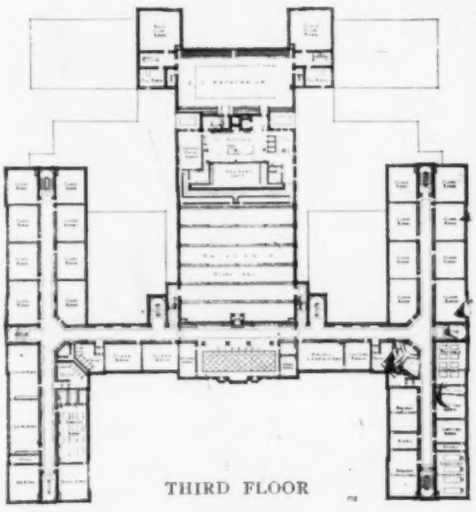
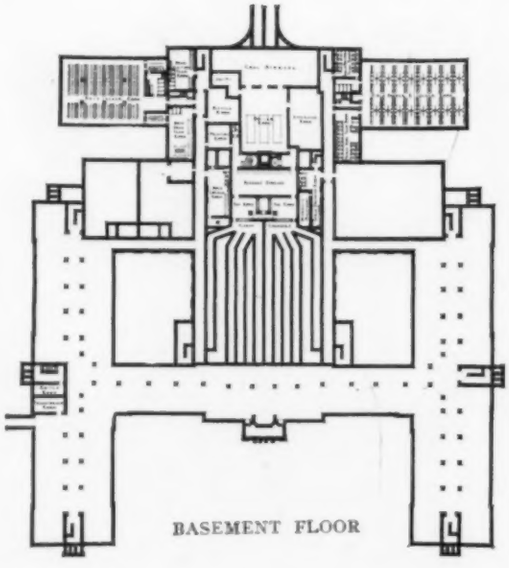
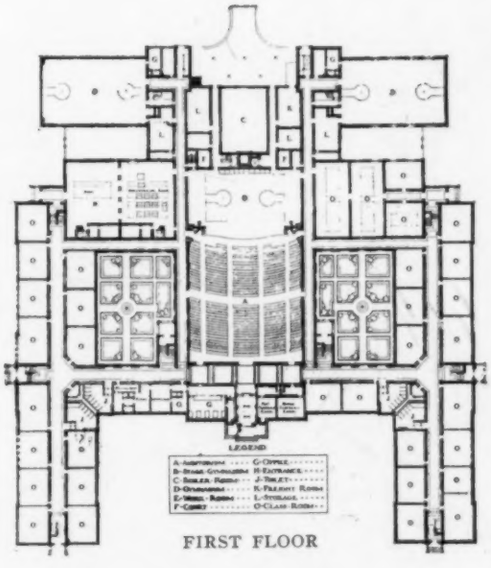


THIRD FLOOR



BASEMENT FLOOR



FIRST FLOOR

CLEVELAND HEIGHTS HIGH SCHOOL, CLEVELAND
WARNER, McCORNACK & MITCHELL, ARCHITECTS

THE NEW SCHOOL BUILDING, THE ARCHITECT, AND THE BOARD OF EDUCATION

BY

JAMES O. BETELLE

OF THE FIRM OF GUILBERT & BETELLE, ARCHITECTS

THERE will always be a demand for new school buildings or additions to old schools as long as our country continues to grow and remains a democracy. At the present time there are hundreds of thousands of school children in the United States housed in makeshift buildings, portable schools, rented spaces and dwellings, stores, annexes, attics and basements. There are an equal number or more attending school only part time, and in addition to this, every city has a greater or less number of overcrowded classrooms. From this it can be seen that crowded school conditions exist today, and they probably will always exist for the reason that like all public work, school accommodations are added slowly and are always behind the actual needs. The demand for additional school accommodations manifests itself in a number of different ways. Its first symptoms are overcrowding in classrooms, then the renting of outside accommodations or the erection of temporary portable school buildings on the school grounds. When conditions have reached such a stage as this, there is not much for the local board of education to do to convince the citizens that additional school accommodations are necessary. The crowded conditions and the part-time classes have probably so upset the daily routine of the homes that the demand for more accommodations comes from the citizens rather than from the school board.

An architect is always interested in the erection of a school building or the development of a school building program. He is interested, first as a citizen and taxpayer, and second as an architect, whose business it is, among other things, to design and supervise the erection of school houses. This article will discuss the various phases of an architect's interest in the new school building, from both a business and a personal standpoint.

After the need for additional school accommodations is recognized, the intelligent thing to do is to ascertain the extent of the need and to decide upon a remedy. If merely an addition to an old structure, or the erection of a single new building is necessary, the situation is comparatively simple. It may happen that the community in question has, for one reason or another, neglected its school buildings, or that the community has experienced unusual growth, with the indications that further increased additions of population are in store for it. In the latter case, it would be wise for the architect to recommend that an educational survey be made to determine the best means of providing the additional school accommodations needed immediately, and to provide a comprehensive future building program, extending over a period of years. It might not be amiss to say here that the making of an educational survey is a special line of work, wherein the services of an educational administrator are of greater value than any that could be rendered by an architect. While it is true that architects at times attempt to make educational surveys, such surveys have not the value of those made by a trained educator, who has specialized in this type of work. It remains for the educational authorities to outline the problem in the terms of buildings to be erected, their sizes and uses, and then for the architect to work out this problem in like terms. It is no more reasonable for the architect to attempt to do educational work than it is for the educator to do architectural work. Both lines of effort are specialties and are of sufficient scope and importance to be made a life-long study, and it is hardly within the realms of possibility for any one person to know both subjects sufficiently to render creditable service.

In a school building program, the architect should be retained early in the proceedings. If there are not sufficient funds or authority available for retaining the architect to design the buildings contemplated, there should be enough money made available by the board of education to retain an architect for special services and advice until the full appropriation has been obtained. In the case of the selection of school sites, the architect can be very useful. The ideal way to make a selection of a site is for the board of education to place before the superintendent of schools several attractive sites for the building, and ask his opinion as to their advantages from a school administration standpoint, and at the same time to ask the architect's views from a building standpoint. What may appear to be an impossible site on account of grades and topographical peculiarities, may develop into a very advantageous site under a skillful architect. What may appear to be a good building site to the layman, may upon investigation by the architect prove to be unsuitable for some such reason as wet soil, underlying rock, or the limited bearing power of the ground. After the question of site has been put up to both the superintendent of schools and the architect, and they agree on the same site, there can be little ground for argument, but should they differ on the site to be selected, it then becomes the duty of the board of education to weigh the merits of the case and come to a decision which will be for the best interests of the community.

The adoption of a building program covering a period of years by the board of education has many advantages. It permits the selection ahead of time, and for that reason allows the purchase of school sites at reasonable prices, thereby often saving thousands of dollars to the taxpayers. The adoption of a building program permits these sites to be selected at proper locations long before those particular parts of the community have been built up, and when large

tracts of land of sufficient sizes for school purposes can be obtained at relatively low prices. It is to be regretted that many communities wait until everything is built up and more school accommodations needed before purchasing sites for schools. This means that the size of the site is restricted and the small piece of ground obtained is very expensive, due to the surrounding improvements.

An element in regard to the erection of a new school building that is of primary interest to the architect is the point of view of the board of education in making a selection of an architect to do the work, and it is probably of equal interest to the board of education to know the points of view of the architects who are being considered in connection with the work. Every owner naturally wants to secure the finest and largest possible school building for the money available, and every architect who is in touch with the school board naturally feels that he should be selected to do the work. With this situation confronting a school board, it is not an easy task to select an architect, as each candidate for the work has his friends and adherents, and they do not hesitate to press the claims of their favorites upon the individual members of the board of education. The board is a public body, and as such is in duty bound to give courteous and patient attention to the claims of the various architects.

The final selection may be arrived at in one of three ways. First, the board may invite a number of architects to appear on a certain evening at a special meeting and then give each candidate a few minutes to tell his story. This is the most unsatisfactory way of any, because after interviewing a few candidates the members of the school board, who are already tired out from a hard day's work before the evening meeting, are practically exhausted after hearing two or three architects endeavoring to sell their services,—and the half-dozen yet to come get but little consideration. Besides this being an unsatisfactory way for an owner to select an architect, it is undignified and almost humiliating as far as the architects are concerned. To wait in an anteroom with possibly ten or a dozen fellow architects, all scrambling for the same commission, and kicking one's heels together until it is time to be called by the board and given a few minutes to tell his story, is not a very inspiring sight or a dignified position for a capable architect. The selection of an architect made on this basis is sure to end in regrets. The architect is placed in an unfavorable position from the start. He has not the opportunity or sufficient time to tell his story or answer the questions of the board or to discuss their problems with them. He is also placed on a competitive basis very often as to the price of his services, as well as to what he claims he can do for the money available. It then results in the selection of the architect who makes the most extravagant promises and tells them what a large building he can give them for little money, the great amount of services included in his commission, or for how small a fee he will do the work. The average school building is likely to be a relatively large work in the ordinary architect's office, and inasmuch as the architect is making his living by designing and supervising buildings, he is naturally very desirous of obtaining the commission.

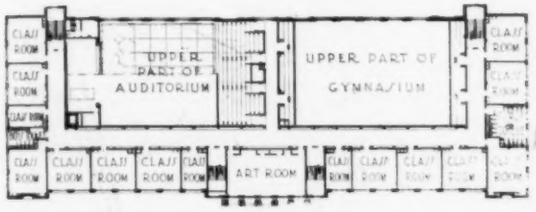
The conservative and reliable architect is not the one usually selected on this basis. He is careful in the statements and promises he makes, and is, therefore, no match for the high powered salesman who agrees with all the demands of the board and describes in flowery language the kind of building he can design for little or no money. If conscientious and upstanding architects would refuse to be parties to such a scramble for work, school boards would soon realize that there are other and better methods whereby an architect can be selected, as the only men responding to their invitation would then be those who were the least desirable to engage. It has been found that reduced architects' commissions or the inclusion of a clerk of works on the site all the time, or payment of traveling expenses, have very little influence with a broad-minded board of education. They are quite willing to pay the usual 6 per cent fee for architectural services of quality, and such concessions tend to lose a good commission for the architect rather than to win it. An architect who agrees to design a building for an absurdly small fee has but little respect for his services,—but then he probably knows what they are worth.

It would seem a fair proposition that if a school board wanted to interview the architect, they should have some process of elimination and select only two or three, and then give each of these an evening to discuss the problem, after which the board can make an intelligent selection. Surely there can be no complaint from the board if the architect agrees to match his time and experience against theirs, with the resultant benefit to both parties. The two or three architects to be given a final interview can be selected and the others eliminated by the issuance of questionnaires, which will set forth the education, office organizations, and past performance of the applicants, together with specimen sets of working drawings and specifications of similar buildings.

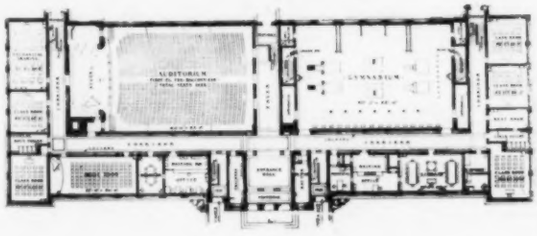
The third method of selecting an architect is on the basis of an architectural competition in which drawings are submitted and a judgment made. It is to be regretted that school boards are not more familiar with the fact that the American Institute of Architects has a standard form of competition program which has been prepared for the convenience of committees proposing to hold competitions, that copies of this document can be obtained by simply writing to the headquarters of the American Institute of Architects, 1741 New York Avenue, Washington, or that they can be obtained from the local chapters of the Institute, located in the important cities of the country. The terms of this program are, of course, familiar to all architects, are easily understood by school boards, and are recognized as

Photos. Drix Duryea

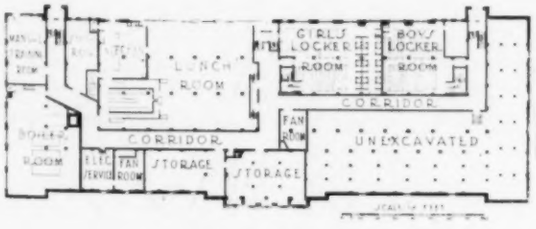
FRONT ELEVATION



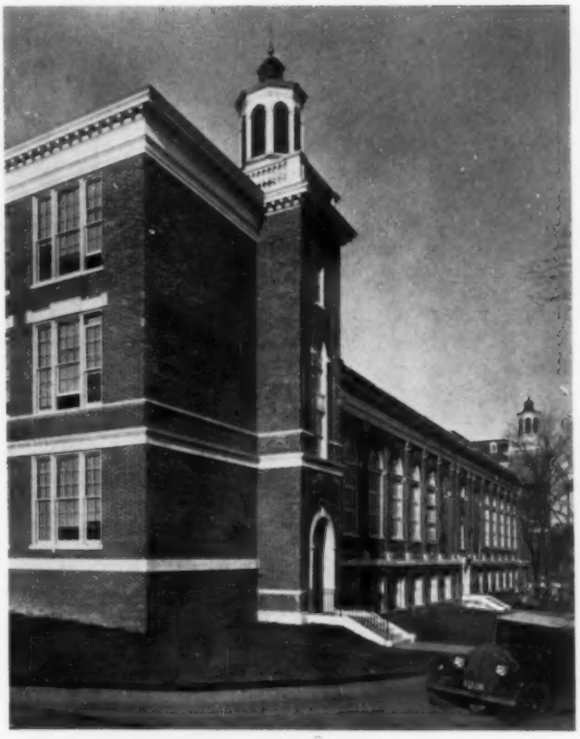
SECOND FLOOR



FIRST FLOOR



BASEMENT



REAR ELEVATION

The architectural treatment of the stairway towers at either end of the rear elevation is one of the interesting features of the Greenwich High School. Both the auditorium and the gymnasium are located at the back of the building on the first floor level.

GREENWICH HIGH SCHOOL, GREENWICH, CONN.

GUILBERT & BETELLE, ARCHITECTS

fair to both the owner and competitor. It is strongly recommended that school boards, which have in mind architectural competitions for school buildings, obtain copies of this competition circular and program, and they will find that the good results obtained by its use will justify their action.

Assuming that the architect has been selected, he should not only get acquainted with the members of the board of education, but he should get in especially close contact with the superintendent of schools. After all, the superintendent of schools is the executive officer of the owner, and it is to him that the owner looks for guidance, not only in educational matters, but also as to the requirements for the new school building. It will be found that school superintendents are now much better informed with regard to the requirements of an up-to-date school building than they have been in the past. Inasmuch as the school superintendent has a working knowledge of the building requirements and can discuss them intelligently with the architect, it is as little as the architect can do to know the operation of a modern school, to study the educational requirements of the superintendent, and to try to understand his point of view. The best results can be obtained only through this knowledge, mutual understanding, and respect. There are many items of information that the architect will have to know in a preliminary way before starting to make sketches for the new building, such as the kind of school needed, what is to be its capacity, a survey of the site, and other details.

Generally the appropriation has been made before the architect is engaged, but now and then it happens that the appropriation has not been made, and this is a better situation, as far as the architect is concerned, than having a definite sum of money allotted for the new building. As a rule, the appropriation is nothing more than a guess, and the requirements and ideas of the board do not correspond to the amount of money appropriated, as the appropriation is small and the ideas are large. So, if the appropriation is still to be made, the architect is in a good position to start his sketches on proper lines and to advise the board as to the cost of the building after the sketches have been adopted, and the proper amount of money obtained before the bids are received.

It should be realized early in the situation that most states have departments of education, which in turn have sub-divisions which must approve and pass on plans for new public school buildings before they can be erected. It is, therefore, incumbent upon the architect to obtain a copy of the state school building law and the latest regulations of the department having in charge the erection of school buildings. Even if the architect has designed other school buildings in the same state, he is likely to experience regret unless he obtains the latest rules and regulations of the department early in the sketch stage. If he does not, it may be embarrassing later on and possibly mean expensive alterations and changes in the plans. After the sketches are drawn and reach the stage of meeting the approval of the owners, it is then wise to send prints, or better still take them personally, to the state department of education and go over them with the individual in charge of buildings. This will make sure that the sketches are along lines that will be finally approved when the working drawings are completed. If this procedure were always followed it would save heartaches and much unnecessary expense to architects who have failed to submit their plans in sketch form, but waited until the working drawings were completed and then found that fundamental changes in their layouts were required by a department of education.

With regard to the plans of the building, we hear a great deal these days about standardization. As far as the general plan of the building is concerned, no standardization is possible if the building is to meet the requirements of the particular community in which it is built, and fit the site and be in character with the surroundings. Standardization of detail is possible in large cities or in architects' offices making a specialty of school building design. These standards apply only to such things as stairs, classroom fittings, toilet rooms, equipment of special rooms, etc., but never to the layout or general plan, as this has to be designed to fit the individual needs of the building, the points of the compass, the topography and shape of the lot, and other conditions.

With regard to the proper architectural style to be used in a school building, it is hardly necessary to mention the various elements controlling this, but in spite of fear of repetition, it may not be amiss to mention some of the limiting conditions. In the first place, a school building should look like a school and not like a public library or a city hall. The architectural style adopted should be in keeping with the community; that is to say, if the town is in New England with colonial traditions, a Colonial building would be appropriate. If the building is in a college town adjacent to the college buildings which are of Collegiate Gothic, a building of similar style would be appropriate. If it is in California or the southern part of the United States, a Spanish or Mission style might be appropriate, so that local conditions and good taste should govern the style adopted.

With regard to the materials used in a school, it is hardly necessary to say that these materials should be simple and substantial. Elaborate marbles and bronzes and expensive materials are out of character in a public school building, and the architect must realize that he is not building a state capitol. Elaborate decoration, either inside or outside, not only costs money but is inappropriate. A school building has sometimes been called an educational factory or workshop, and it is on that basis that it should be designed. Cheap imitations and substitutes for more elaborate and expensive materials should also be avoided. These imitations and substitutes have not the wearing qualities of the imitated material, and it is much better to get a simple and substantial building than an elaborate structure built of substitutes.

A school building, while not occupied many hours in the day, is nevertheless subjected to excessive wear. When it is realized that the building houses thousands of pupils and that they change classes every 45 minutes or thereabouts, it can be seen that tremendous wear is received and that only the most substantial materials will stand up under it. A simple, straightforward, businesslike building is looked upon with favor by the taxpayer, who has no objection to paying for the essentials, but who finds fault with what he considers undue elaboration and expense in connection with school buildings.

In connection with the materials to be employed, a word about the use of new materials and appliances might also be in order. The careful architect will go slowly in specifying any new material or appliance for use in a school building. In private work the architect may be a pioneer and, with the consent of his client, try out and adopt any new apparatus or material that strikes his and the owner's fancy, and which his judgment dictates as appropriate. In a school building the situation is different; this is a public structure and every taxpayer is a part owner. If new materials or appliances are adopted and turn out failures, every citizen and newspaper has a right to criticize; whereas if they turn out satisfactorily, no particular credit is given the architect for taking the chance. This is quite different in a privately owned building, as whether it turns out satisfactorily or otherwise is the concern of no one but the architect and his client. High powered salesmen are continually importuning the school architect to adopt new materials and methods and new appliances, and if an architect succumbs to their high powered methods, he may sooner or later find himself in an embarrassing position. It is a good principle to insist that any material or appliance entering into a public building have a background of a number of years of successful use and a number of satisfied users. "Safety first" is a good motto.

In connection with the layout of the plan, it may be found that the demand for space and capacity is more than it is possible to meet and keep within the sum which it is possible to have appropriated. This is where the skill, experience and knowledge of the educational demands, on the part of the architect, are very valuable. It has been previously said that the architect should know something of educational requirements and routine, and he is then in a position to show how economy in space can be carried out and educational demands still met. There are many different types of economy, such as economy in materials, economy in layout, and economy in use,—that is, the school building used to capacity without unnecessary and idle rooms and spaces. Each of these types of economy must be used with discretion and judgment; otherwise they become false economies, which constitute a form of extravagance. Another type of economy, and after all economy must be practical if we are to meet the tremendous demands for new school buildings, is the economy brought about by the duplicate use of rooms and spaces. This duplicate use is where a single room is used at different times for one or more purposes, such as a combination gymnasium and auditorium; the use of the lunch room for school purposes except during the middle of the day; a combination sewing and cooking room; or a combination physical and chemical laboratory. These duplicate uses are not as satisfactory as having separate rooms for each and every purpose, but in a small school where the scholars are not of sufficient number to use the special rooms 100 per cent of the time, such economy is necessary, as spaces which are vacant the greater part of the time cannot be justified.

A school building was never known to be large enough to be adequate for more than a few years, so that it should be made flexible in order that future additions can be readily made; in fact these future additions should be planned and thought of from the start, and indicated on the preliminary sketches. It should also be flexible in that partitions can be moved and altered without affecting the structural features of the building, as this may be necessary as time goes on, inasmuch as educational methods change.

To get full value out of a school building it should be planned so it can be used by the citizens for community purposes. It is not only the auditorium and gymnasium that can be so used, although these are the first thought of. The kindergarten can be used for small social gatherings, dances or meetings of the Parent-Teachers' Association. One of the classrooms which has movable furniture can be used for a men's debating club, and in combination with all these purposes the lunch room is always useful. There are other community uses for our schools that do not interfere with their primary purpose, and if we want the community to stand back of the schools, we should encourage their use to the fullest extent.

It is often asked what is the proper number of stories in height for a school building, from the standpoint of desirability and cost. For the purposes of this article, school buildings over three stories high can be ignored, as they are only suitable in large cities, such as New York or Philadelphia, where ground area is not available, and where necessarily the building must be high in order to get capacity. Like all other decisions, the proper thing to do can be determined only by knowing all limiting conditions. Generally speaking, a two-story building is desirable where sufficient land is available; this means only one flight of stairs to climb, and it makes a very safe type of school in case of trouble. A two-story school is in better scale with the surrounding houses than a three-story building. A three-story structure is better for a high school, where the pupils are older, than it is for a grade school. A one-story school has its uses and also its limitations; while large one-story schools have been built, they spread over such large areas as to become unwieldly, and a two-story building in such cases is much better. It would seem that a maximum

size for a one-story building, especially where an auditorium and gymnasium is to be included, would be not more than 10 to 14 classrooms. As to which type of building is cheaper, the single-story or multiple-story, there are figures available to prove either way you want it. The decision as to the number of stories in a school building should not be based on cost. The differences in cost between the different types of same size and capacity are not sufficient to be the deciding factors. The deciding factor should be what is wanted or what is thought to be proper under the particular circumstances of the case.

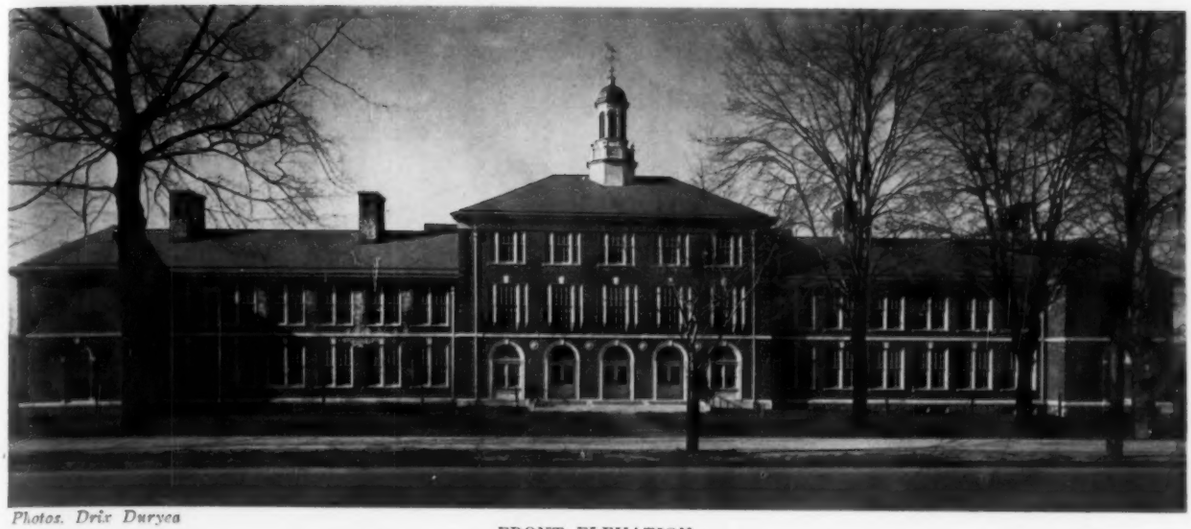
It is realized that school building costs are always of interest, but they are very difficult to state accurately or in such a way that they would be very useful. These school building costs vary from year to year, due to labor and material market conditions, and in various parts of the country due to local labor and material costs. Prices in the New York metropolitan district do not apply elsewhere, and the architect will have to depend upon his own knowledge of local conditions and building costs to approximate the cost of the proposed building. It has at times been suggested that approximate estimates be obtained from contractors on sketch plans and memoranda specifications. This sounds like a good method, inasmuch as the contractor who deals with costs all the time is in a better position to make a price than the architect could be. In practice, however, this does not work out. No contractor is going to take the time and trouble to take off quantities or carefully go into the cost of a proposed school building, for the reason that he is too busy figuring on actual work and constructing the buildings he has contracts for. Out of courtesy to the architect he makes up some sort of a price, and he sometimes asks what the architect wants it to cost, and, trying to be accommodating, he puts it in at that figure, so that in the last analysis preliminary figures from contractors on sketch plans are useless, especially as there is no responsibility attached to the contractor and no commission to be given out at that particular time; all of which is not very encouraging to accuracy. The architect must, therefore, make up his own figure as to the cost of the building, based upon his knowledge of costs and experience in buildings of similar kinds,—and stand or fall by the result.

There are several methods of stating the cost of a school building, and one of the oldest methods and one still in the minds of school boards and school superintendents, is the "cost per classroom." Years ago, when a school building was simply a box-like structure divided into so many equal parts, each of which was a classroom, it was very easy to determine the cost of the building per classroom. Today, with all the various activities in our schools, especially high schools, it means there are rooms of varying sizes, such as laboratories, shops, libraries, etc., all of larger size than the standard classroom, and in addition, lunch rooms, auditoriums, gymnasiums, and similar large spaces; so it is obvious that the cost per classroom is not now the basis on which to state the cost of a school building. Another method is to find the cost of a school building "per scholar." This is more definite than the classroom basis, but still somewhat indefinite, due to different methods of computing the scholar capacity of the building. The American Institute of Architects and the National Education Association have fixed upon a method of computing the number of scholars accommodated in a school building, and it might be useful to describe this method here: "Compute the number of pupils normally accommodated in rooms designed for classes only. Special rooms are to be figured at the actual number of pupils accommodated for one class period only. Auditoriums and assembly rooms are to be ignored, but gymnasiums may be figured for one or two classes, as the accommodations may provide. No gymnasiums, however, shall be accredited with two classes, if below 40 by 70 feet in size."

The most accurate way and the most familiar way of stating the cost of school buildings is the same way architects state the cost of any other building, and that is the cost per cubic foot. All architects know how to compute the cubage of their buildings, and they are based on more or less the same methods. Since it is felt that a cubic foot method is the most suitable, it might not be amiss to give some figures as to cubic foot costs, even if they do not apply to all parts of the country or at all times. The average fireproof school building, outside of New York, costs from 45 cents to 50 cents per cubic foot. As we get farther away from New York the labor costs are less and there is a corresponding reduction in prices. A building of semi-fireproof construction can be built for from 35 to 40 cents per cubic foot in the eastern section of the United States.

Another item of interest is the number of cubic feet per scholar in a school building. This varies in different types of schools, averaging around 800 to 1,000 cubic feet per scholar in a grade school; 1000 to 1200 cubic feet per scholar in a junior high school, and 1200 to 1500 cubic feet per scholar in a senior high school. If an architect were asked the cost of a 600-pupil high school, he would not be very far wrong if he figured out in his mind, 600 scholars times 1500 cubic feet per scholar, or 900,000 cubic feet; which multiplied by the cost per cubic foot that the architect determines is the price in his particular district, gives a quick and close approximation of the probable cost of the building. The basis of cubic foot per scholar is on the usual school building without any extraordinary facilities in it, being simply the average. If facilities out of the ordinary are added or omitted, the number of cubic feet per scholar should be adjusted accordingly.

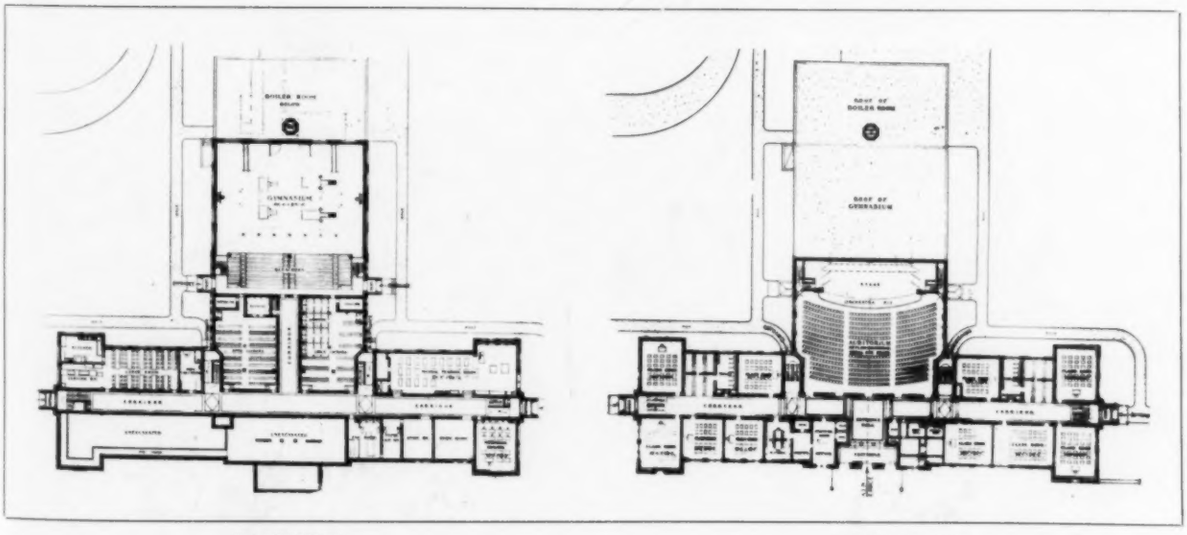
Another question coming up in the minds of boards of education is the time required to get the plans drawn and the school building completed after the appropriation has been made. This is something that is again indefinite, but the board's question has to be answered, at least approximately. The



Photos. Drix Duryea

FRONT ELEVATION

REAR VIEW



BASEMENT FIRST FLOOR

WASHINGTON IRVING HIGH SCHOOL, TARRYTOWN, N. Y.

GUILBERT & BETELLE, ARCHITECTS

part of the work that is going to take up considerable time and cannot be always counted upon is the time given by the board of education to considering the preliminary sketches and deciding upon a definite scheme, which can be adopted and the architect ordered ahead with the working drawings. At the very quickest it takes one or two months to get the preliminary plans adopted by the board, and during that time a number of schemes have been submitted and discussed. After the preliminary plans have been adopted it takes the architect 10 or 12 weeks to make the working drawings, depending more or less upon the size of the building. After this it takes three or four weeks for the contractors to submit their figures, and probably 12 months for the contractor to complete the structure ready for occupancy. Altogether, this means at least 18 months from the time the money is appropriated to the time the building can be ready for occupancy. It can be done in less time, but it generally takes longer than this.

The contractors very seldom finish within the time stipulated in the contract for completion, and one reason for this is the type of contractors who are usually successful bidders on public work, such as schools. It should be realized that price is the only thing that is considered in awarding a contract on public work, for the reason that the law usually prescribes that the contract shall go to the lowest responsible bidder. It is very difficult to prove a contractor is not responsible, especially when he can get a surety bond guaranteeing completion of the work. Contractors of ability and with large organizations will not figure on school work, because they cannot compete in price with the newly organized and inexperienced concerns and the contractor without organization. But as one usually gets what is paid for, the board gets a slow, and possibly unsatisfactory, building from the lowest bidder, whom they would probably not permit to bid on any of their private work,—and the more responsible and efficient builders are eliminated from the situation.

The architect and the superintendent of schools should get together even during the preliminary plan period and decide upon the size and equipment of the special classrooms, such as laboratories, shops, cooking rooms, etc., which are usually built too small to contain the special furniture and equipment needed for their proper use. Each of these special rooms should have the equipment and furniture laid out to scale as the plans are developed, and the architect can with profit get in touch with one of the many equipment concerns, so that when the building is completed these special rooms can be properly furnished. This layout is also necessary in order that the various electric, plumbing, heating and water outlets can be properly located.

The modern American school has shown vast improvements in plan layouts and architectural expression in the past decade, due to continued coöperation between the architect and school authorities.

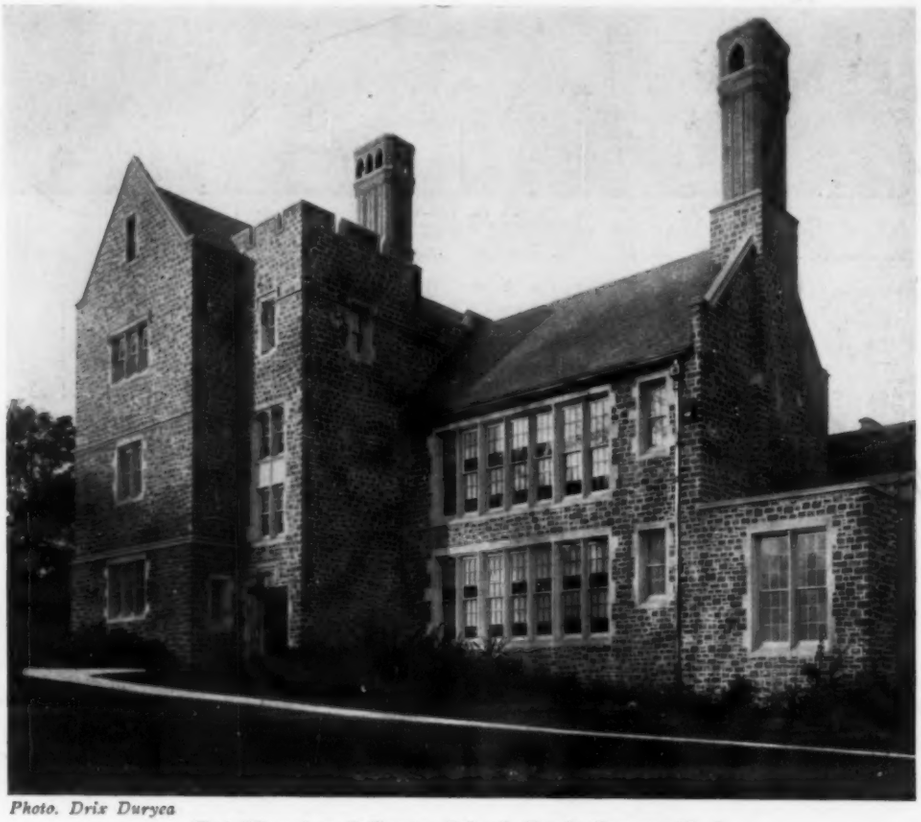
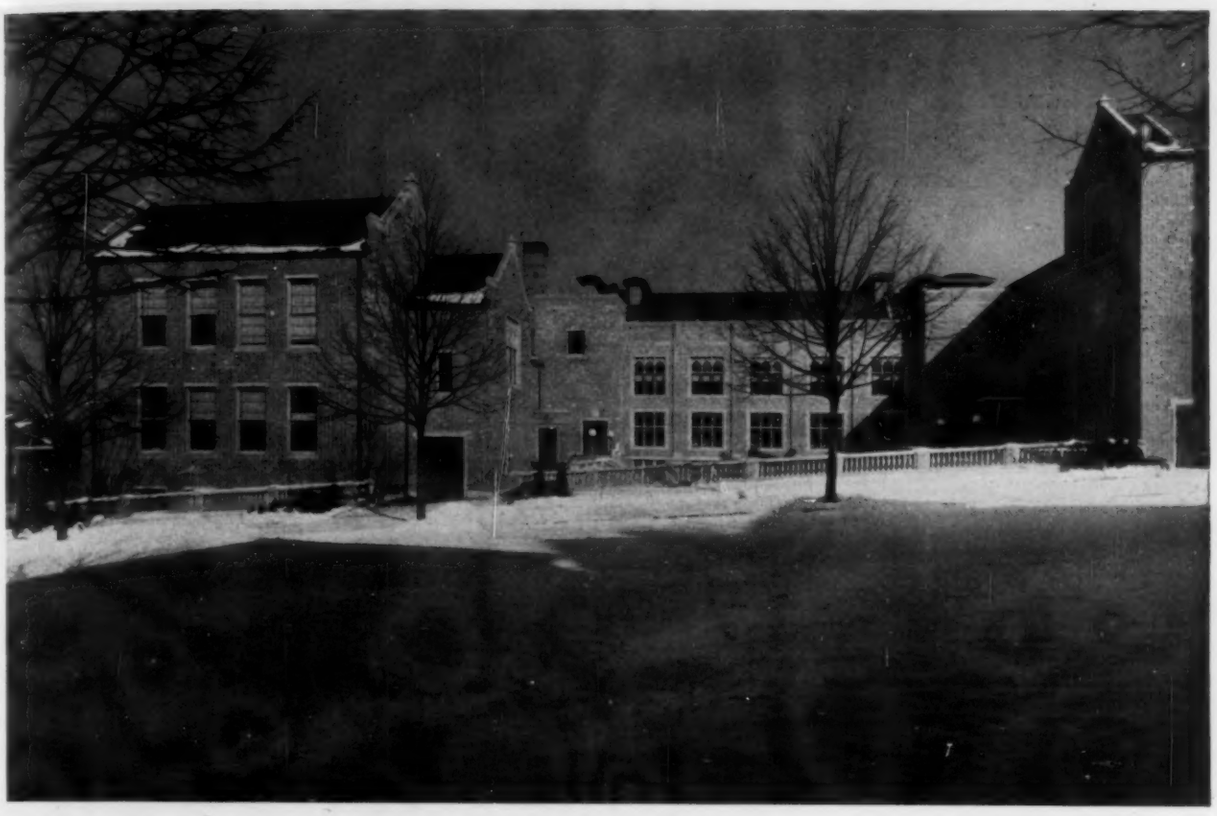


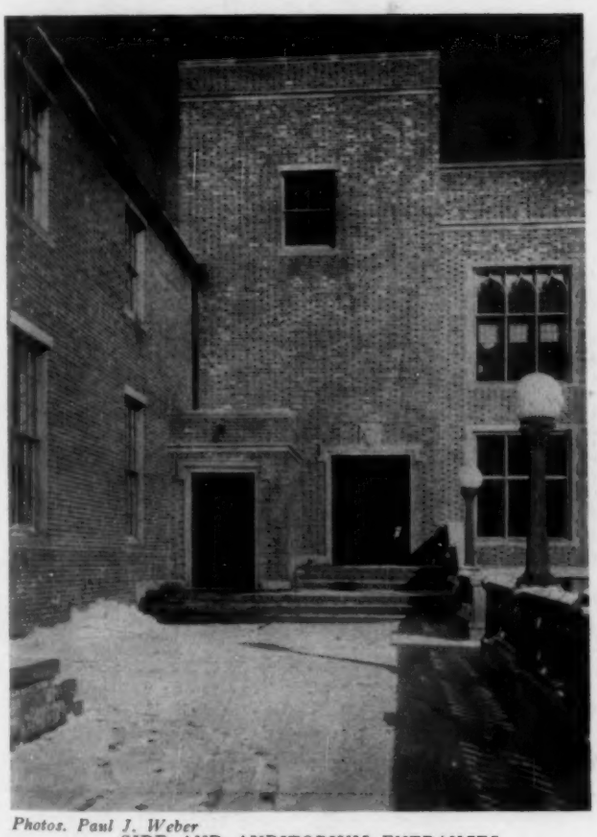
Photo. Drix Duryea

End Elevation, Jefferson School, South Orange, N. J.

Guilbert & Betelle, Architects



GENERAL VIEW



SIDE AND AUDITORIUM ENTRANCES

SOUTHEAST WING

Photos. Paul J. Weber *Plans on Back*

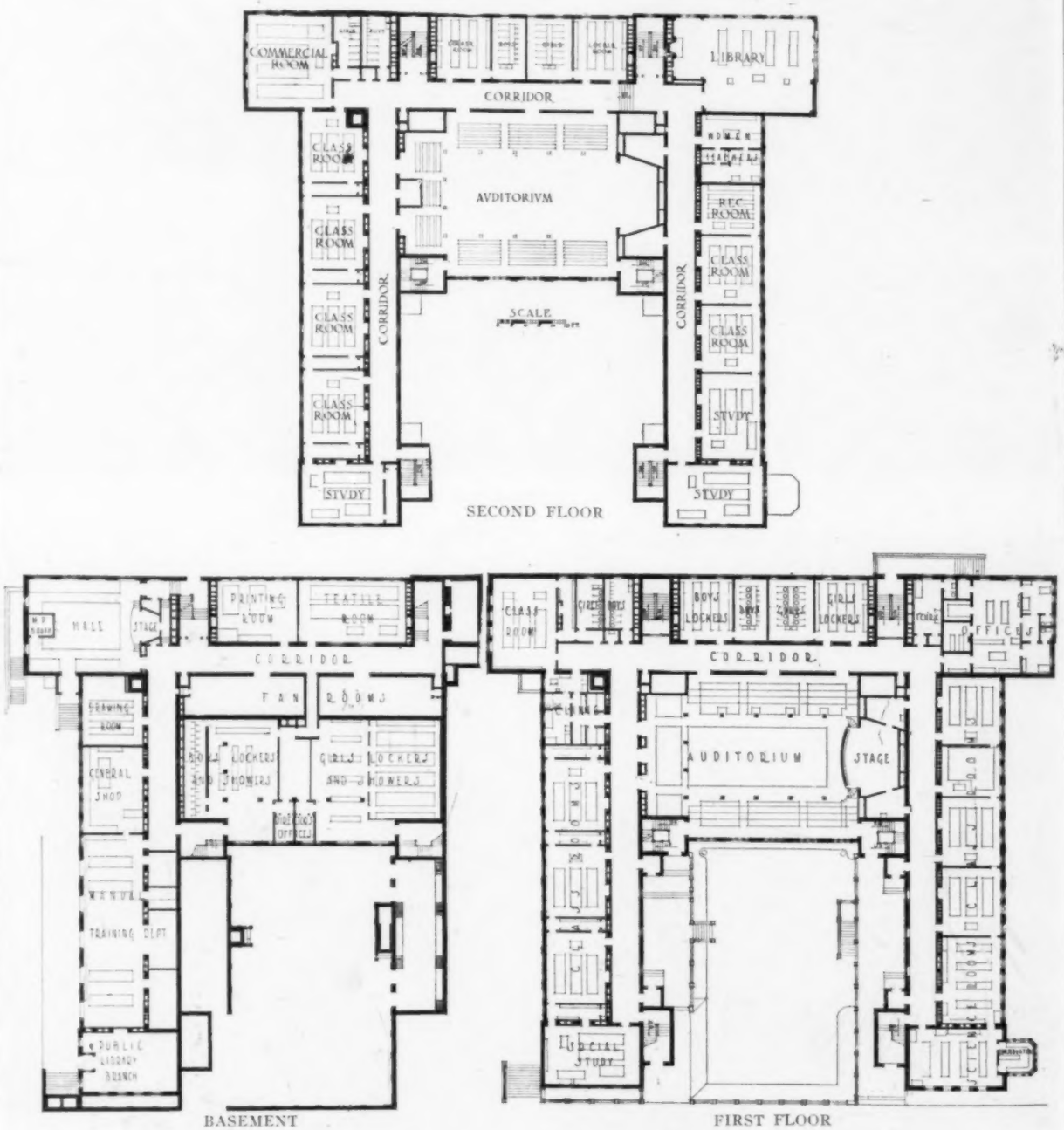
NORTH PARK JUNIOR HIGH SCHOOL, FALL RIVER, MASS.

NATHANIEL S. CHASE, ARCHITECT; R. CLIPSTON STURGIS, ASSOCIATE ARCHITECT

COST AND CONSTRUCTION DATA

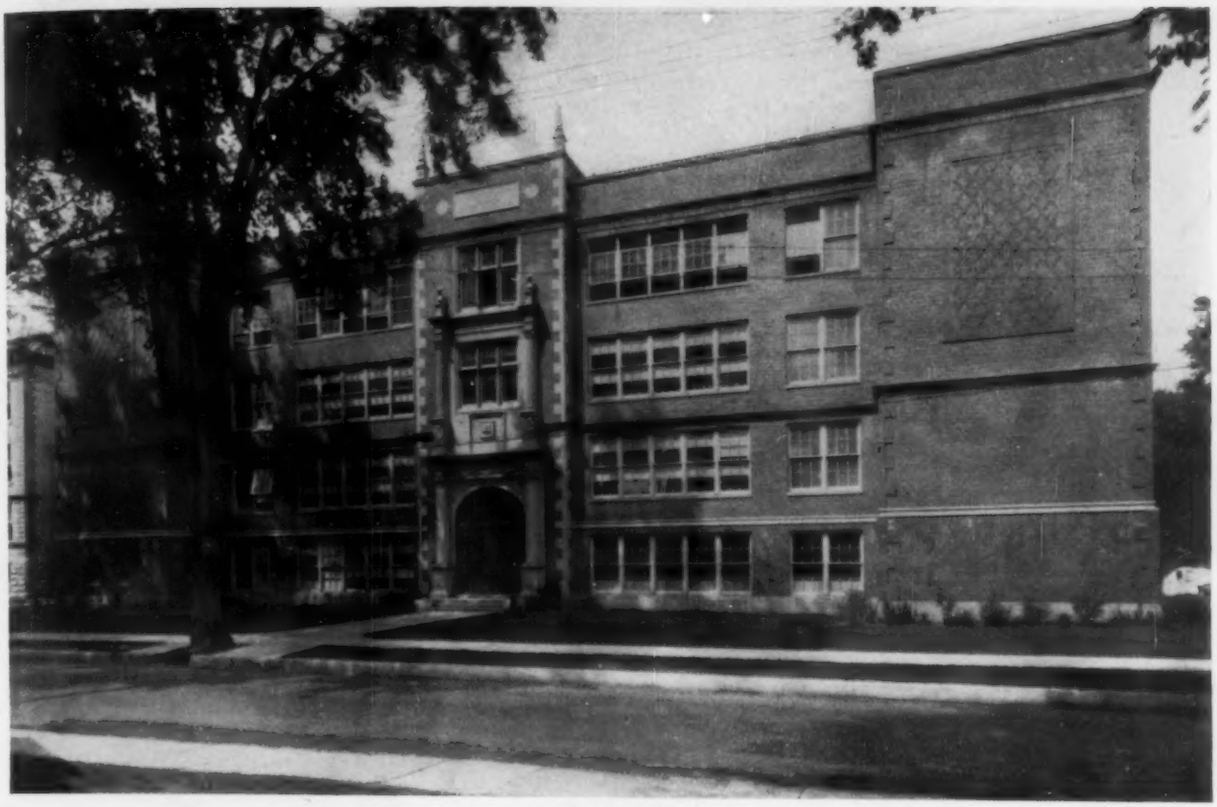
This school was completed in 1924 at a total cost of $685,000, or 53 cents per cubic foot. It is designed to accommodate 1200 pupils, which makes the cost per pupil about $570. Equipment costing $59,000 has been installed in the building.

The construction is fireproof with wood roof structure. The exterior walls are of brick; the roof is covered with slate.

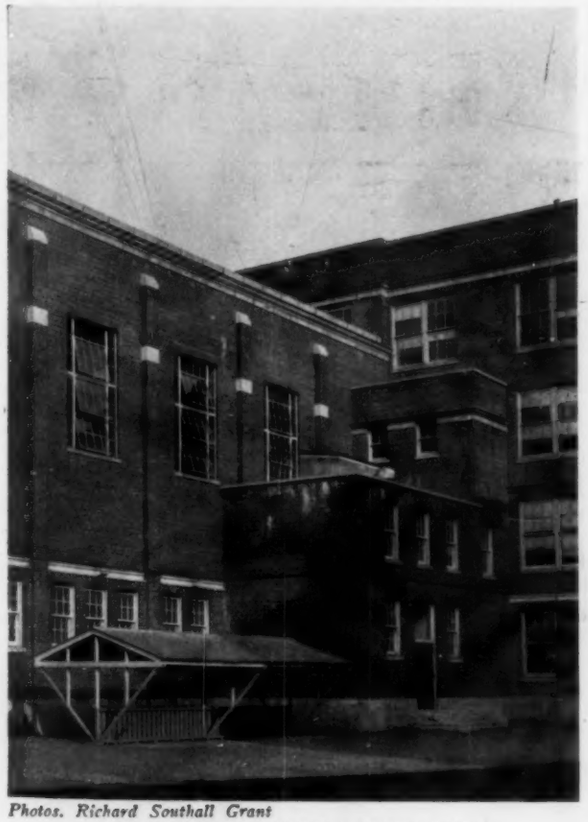


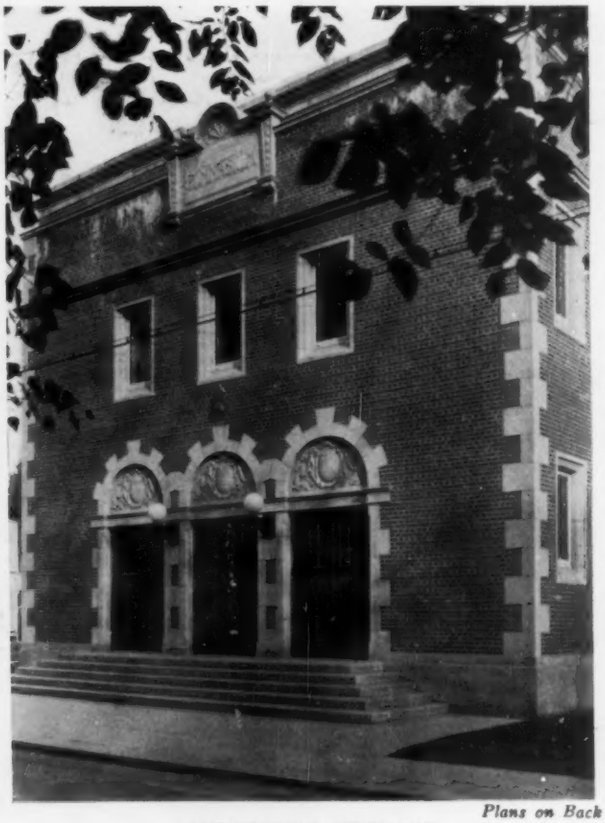
PLANS, NORTH PARK JUNIOR HIGH SCHOOL, FALL RIVER, MASS.

NATHANIEL S. CHASE, ARCHITECT; R. CLIPSTON STURGIS, ASSOCIATE ARCHITECT



GENERAL VIEW





Photos. Richard Southall Grant *Plans on Back*

ENTRANCE TO GIRLS' LOCKER ROOM AUDITORIUM ENTRANCE

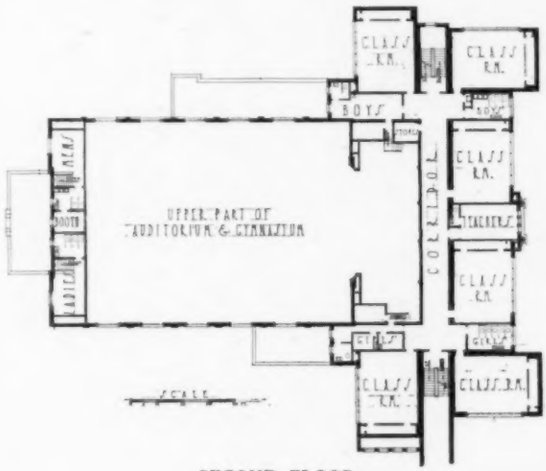
JUNIOR HIGH SCHOOL, GLENS FALLS, N. Y.

TOOKER & MARSH, ARCHITECTS

COST AND CONSTRUCTION DATA

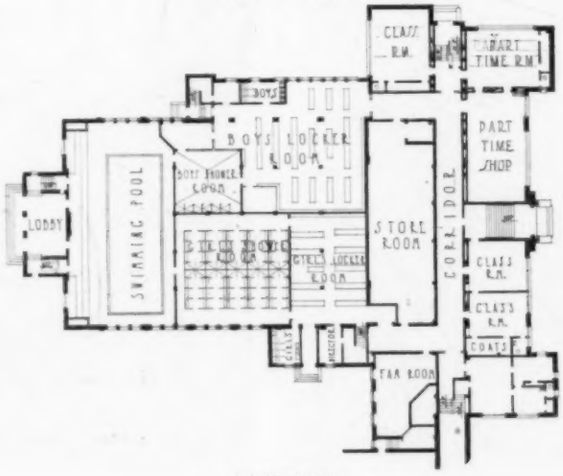
Designed to accommodate 630 pupils, this school was completed in 1924 at a total cost of $360.000, or 33 cents per cubic foot, making the cost per pupil $571.

The general construction is fireproof, the exterior walls being of brick trimmed with tile. The roofing material is asbestos.



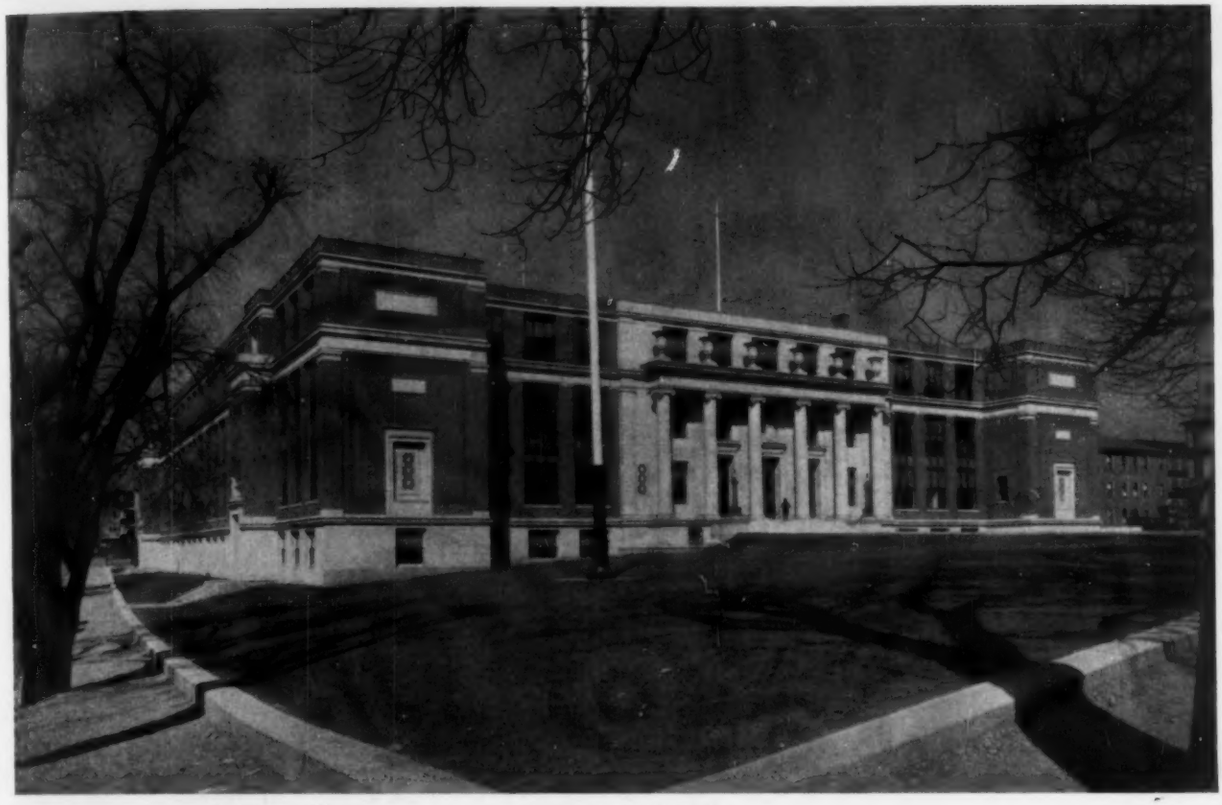
SECOND FLOOR

FIRST FLOOR



BASEMENT

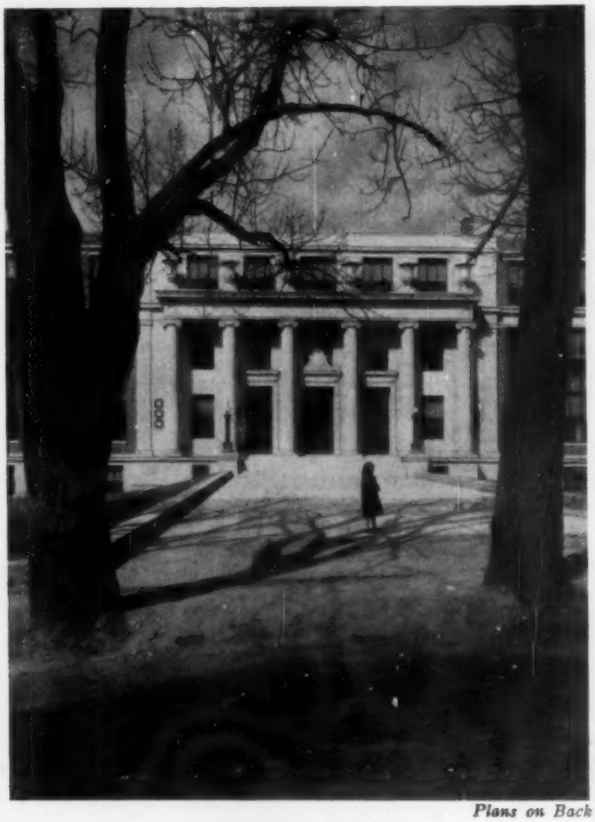
PLANS, JUNIOR HIGH SCHOOL, GLENS FALLS, N. Y.
TOOKER & MARSH, ARCHITECTS



GENERAL VIEW

Photos. Paul J. Weber

GALLERY IN AUDITORIUM



Plans on Back

ENTRANCE PORTICO

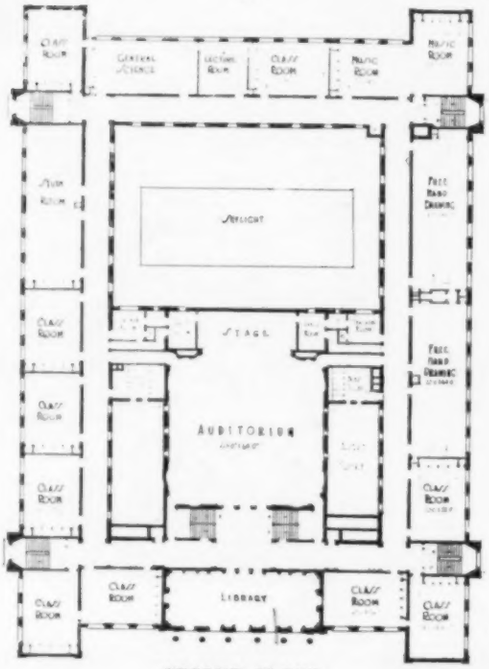
JUNIOR HIGH SCHOOL, WORCESTER, MASS.

JOSEPH D. LELAND & COMPANY, ARCHITECTS

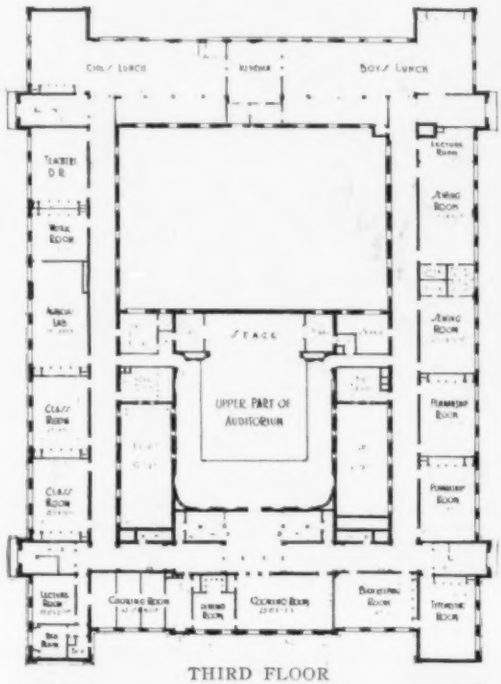
COST AND CONSTRUCTION DATA

Erected in 1922 and 1923, this building has a capacity of 1762 pupils and cost $935,000, not including ground and equipment, making the cubic foot cost 40.7 cents. The cost per pupil is $530.

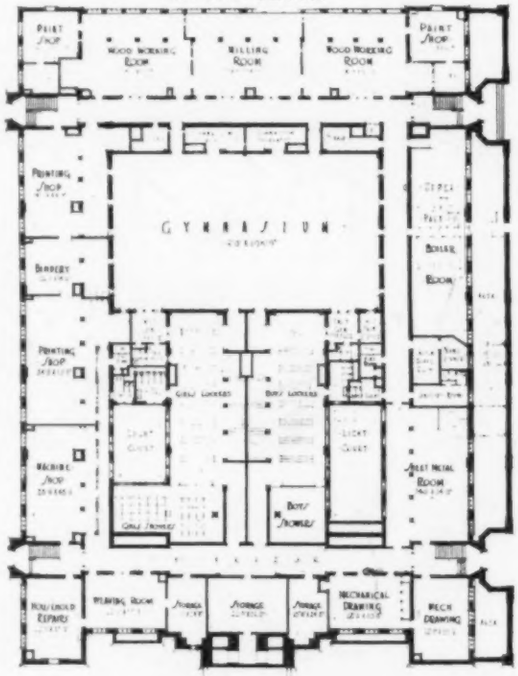
The building has a flat roof and the exterior finish is of sand-struck brick trimmed with artificial limestone. The stairs, corridors, and auditorium are of fireproof construction.



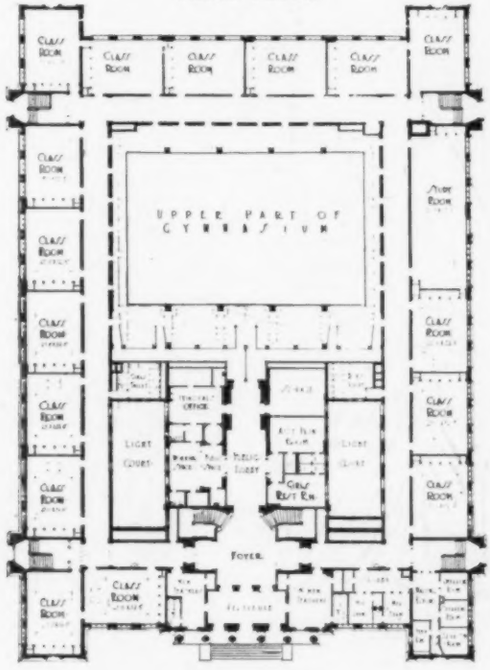
SECOND FLOOR



THIRD FLOOR



BASEMENT



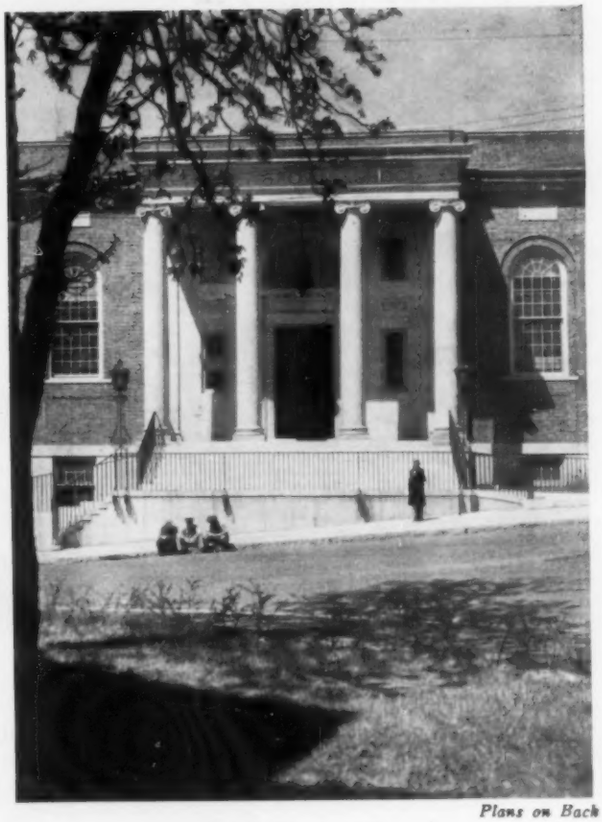
FIRST FLOOR

PLANS, JUNIOR HIGH SCHOOL, WORCESTER, MASS.
JOSEPH D. LELAND & COMPANY, ARCHITECTS

GENERAL VIEW

Photos. Paul J. Weber

SCHOOL ENTRANCE



Plans on Back

MAIN ENTRANCE

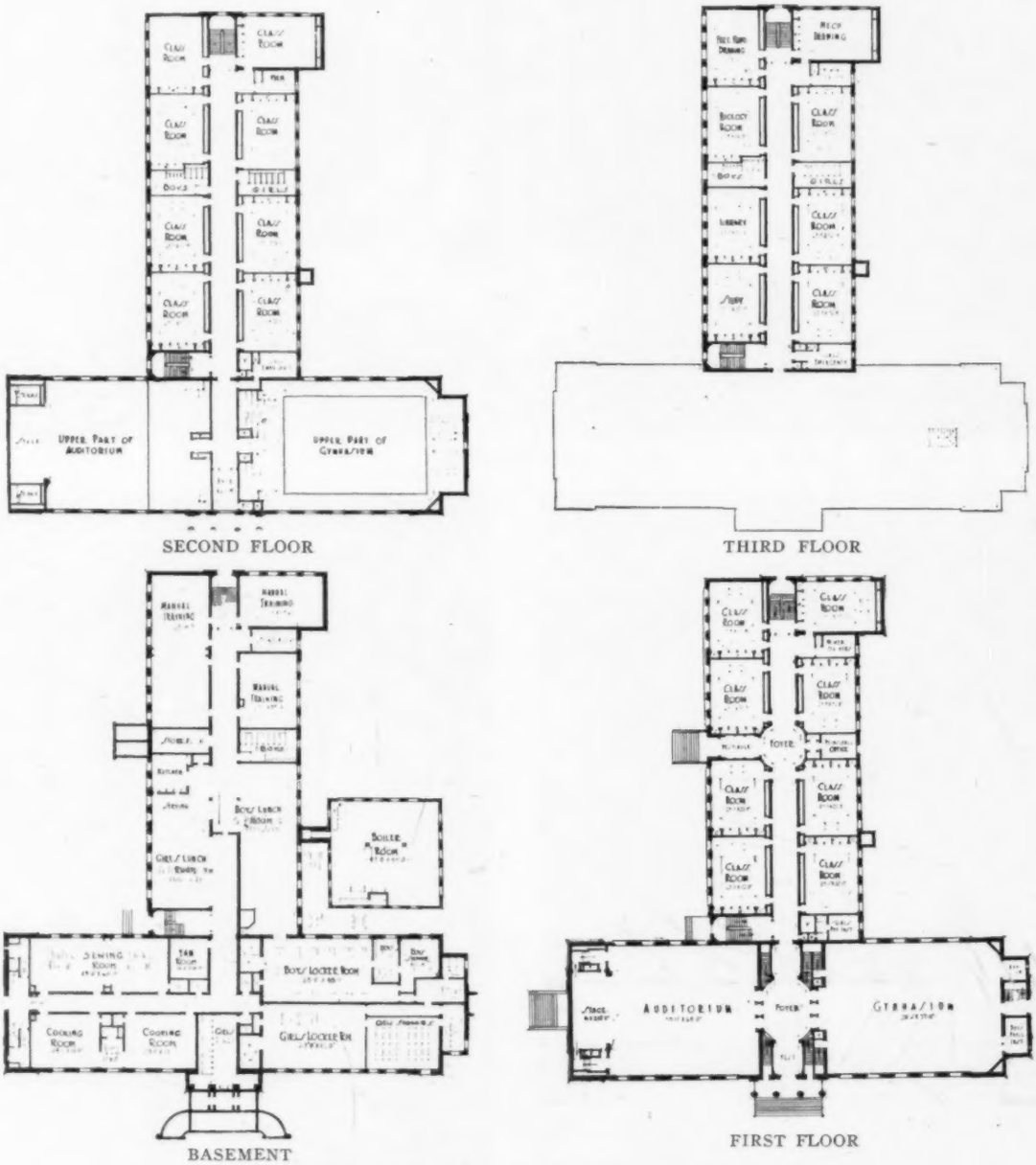
JUNIOR HIGH SCHOOL, FITCHBURG, MASS.

JOSEPH D. LELAND & COMPANY, ARCHITECTS

COST AND CONSTRUCTION DATA

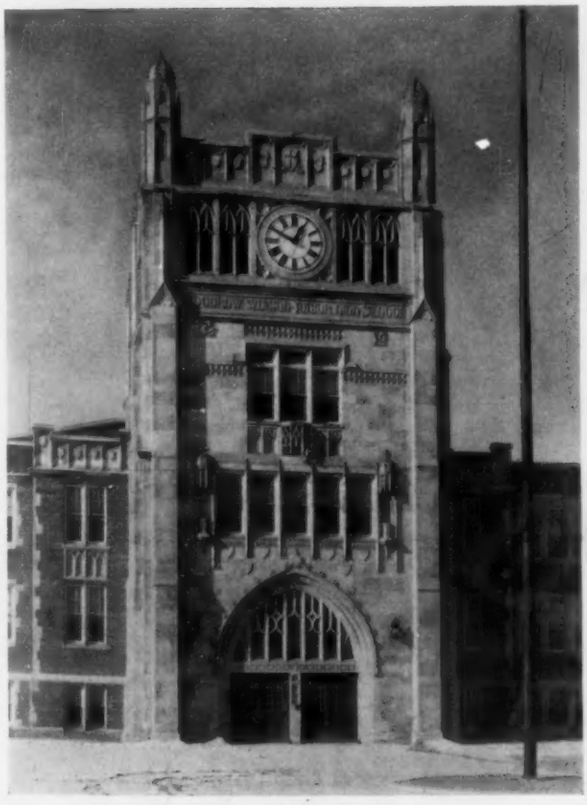
Exclusive of ground and equipment, the total cost of this building was $394,135, or 32 cents per cubic foot. It is designed for 915 pupils, making the cost per pupil $430.

The corridors and stairways are fireproof in construction, and the exterior walls are of red waterstruck brick with limestone trim.

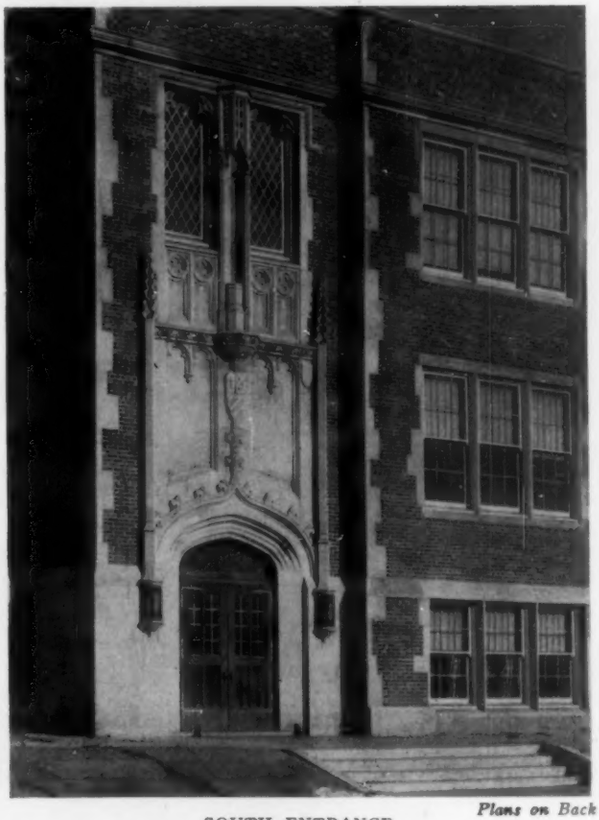


PLANS, JUNIOR HIGH SCHOOL, FITCHBURG, MASS.
JOSEPH D. LELAND & COMPANY, ARCHITECTS

GENERAL VIEW FROM THE SOUTHEAST



MAIN EAST ENTRANCE



SOUTH ENTRANCE

Plans on Back

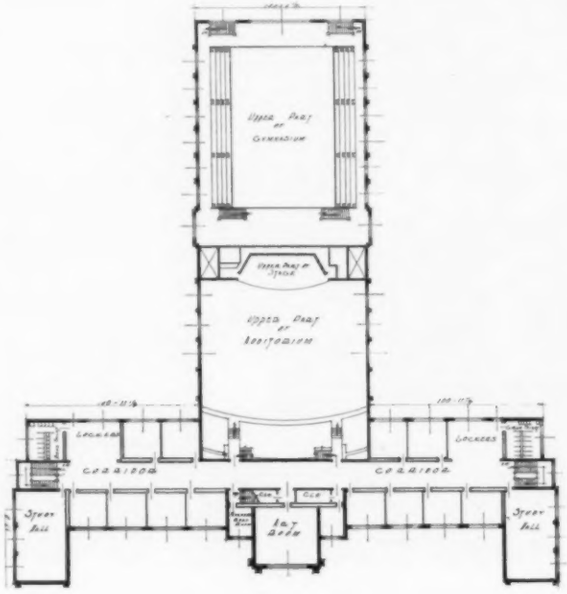
WOODROW WILSON JUNIOR HIGH SCHOOL, TERRE HAUTE

JOHNSON, MILLER, MILLER & YEAGER, ARCHITECTS

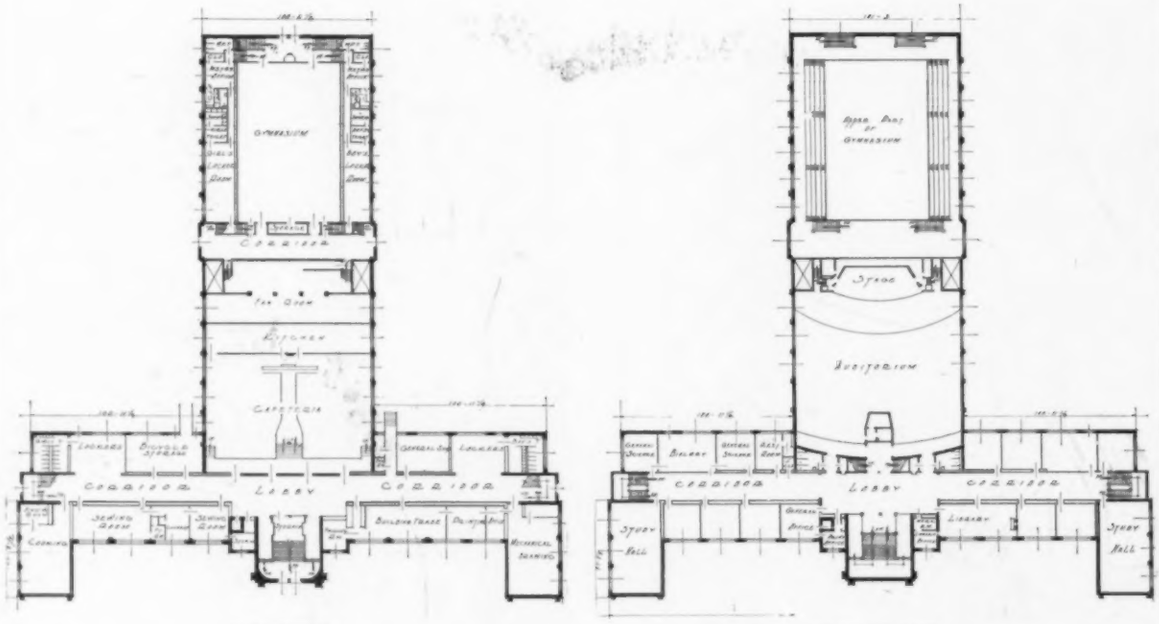
COST AND CONSTRUCTION DATA

Approximately 1800 pupils can be accommodated in this building, which was completed in June, 1927, at a total cost of $687,425, or 24.6 cents per cubic foot. The value of the equipment is $35,000.

Reinforced concrete construction, brick exterior finish and composition and tile roofing make it fireproof throughout.



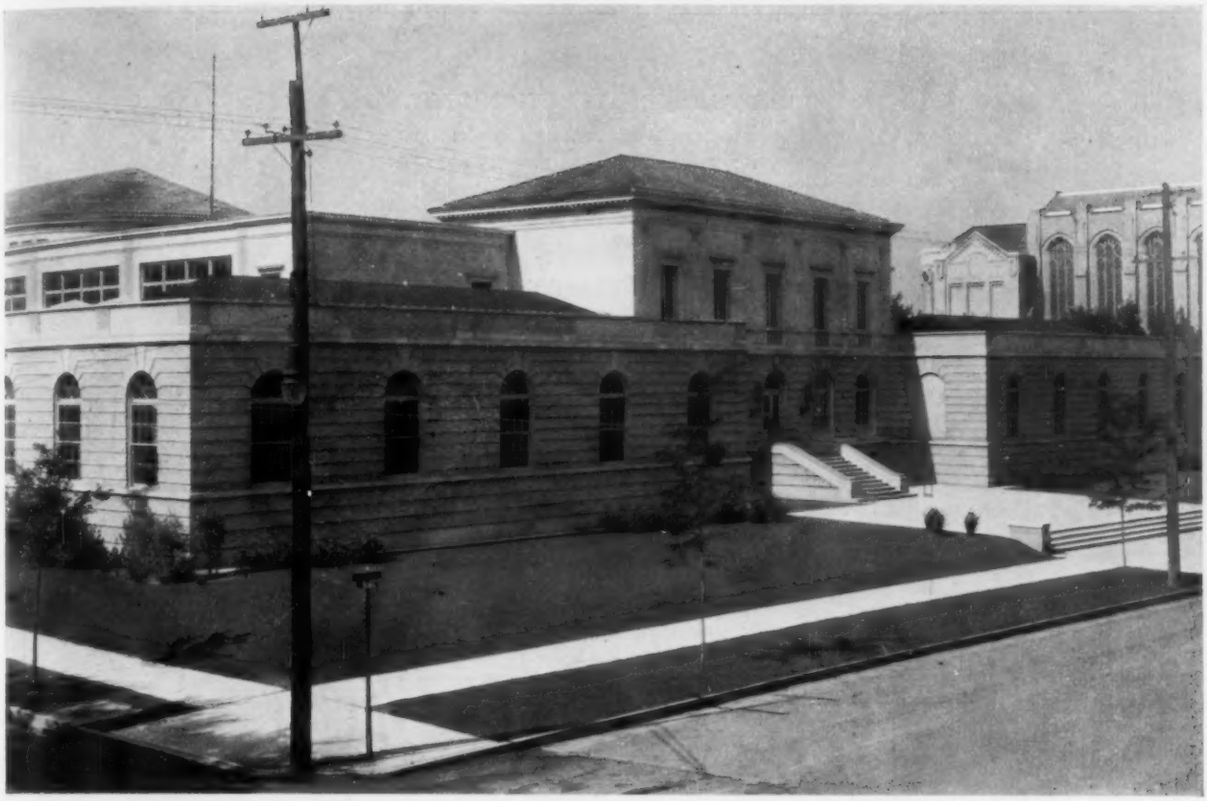
SECOND FLOOR



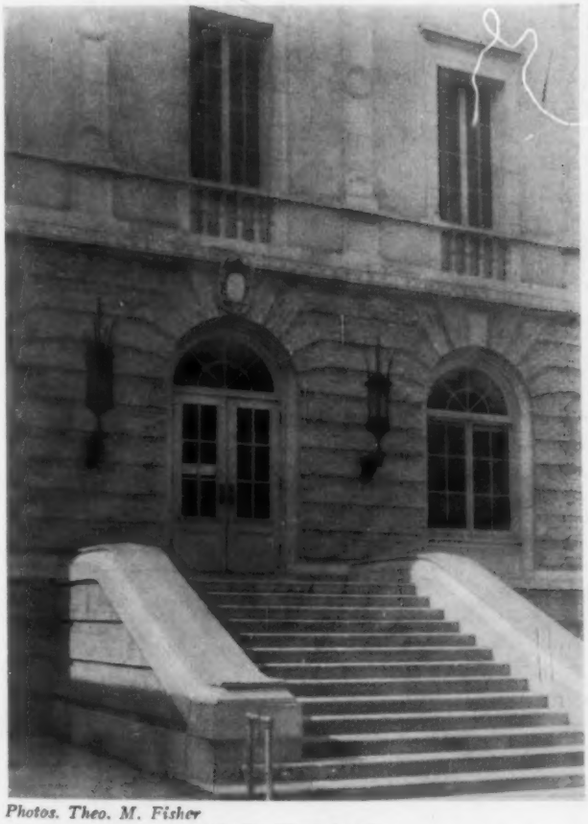
BASEMENT FIRST FLOOR

PLANS, WOODROW WILSON JUNIOR HIGH SCHOOL, TERRE HAUTE

JOHNSON, MILLER, MILLER & YEAGER, ARCHITECTS

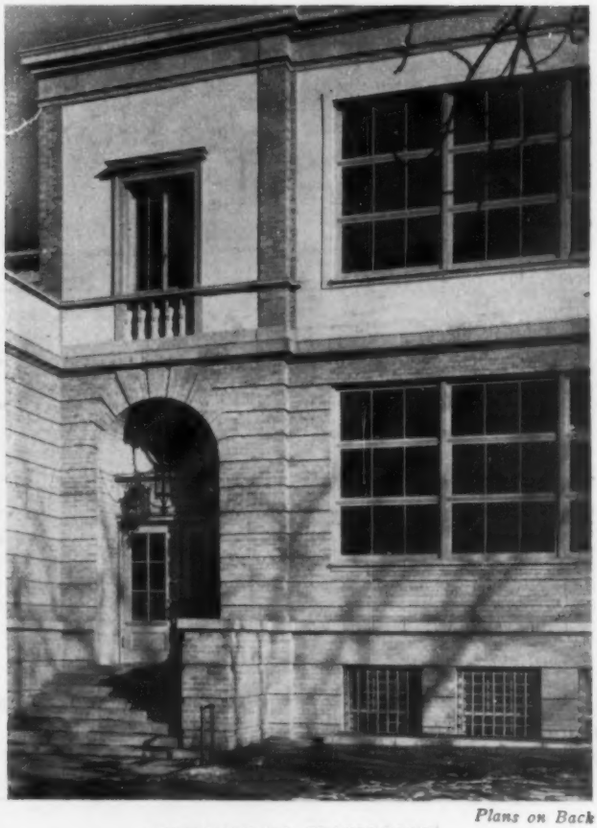


GENERAL VIEW



Photos. Theo. M. Fisher

MAIN ENTRANCE



Plans on Back

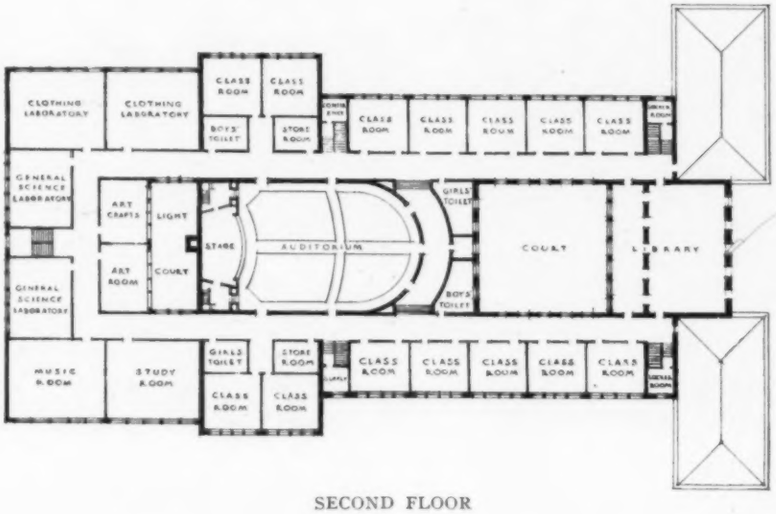
ENTRANCE TO CLASSROOMS

MOREY JUNIOR HIGH SCHOOL, DENVER

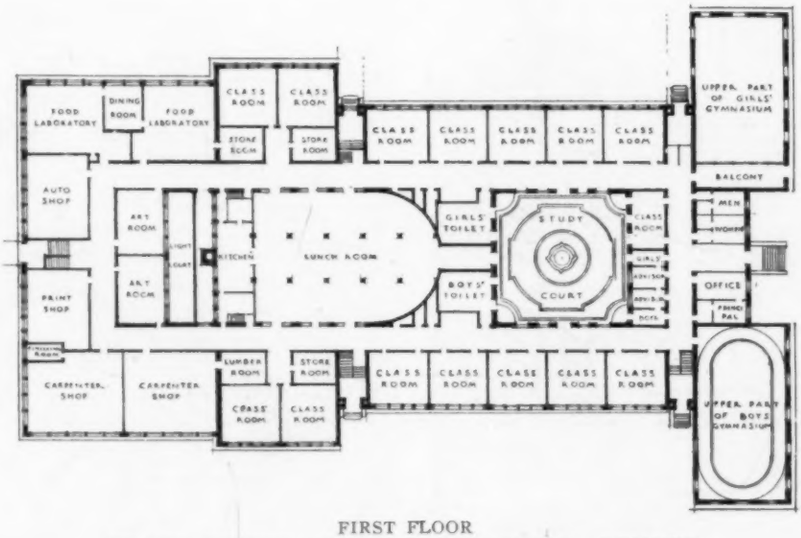
WILLIAM E. AND ARTHUR A. FISHER, ARCHITECTS

COST AND CONSTRUCTION DATA

Constructed of reinforced concrete with tile roof, this building was completed in 1926 at a cost of $775,000, or 40 cents per cubic foot. It has a capacity of 1600 pupils, making the cost per pupil approximately $484. The equipment used in this building cost $40,000.



SECOND FLOOR

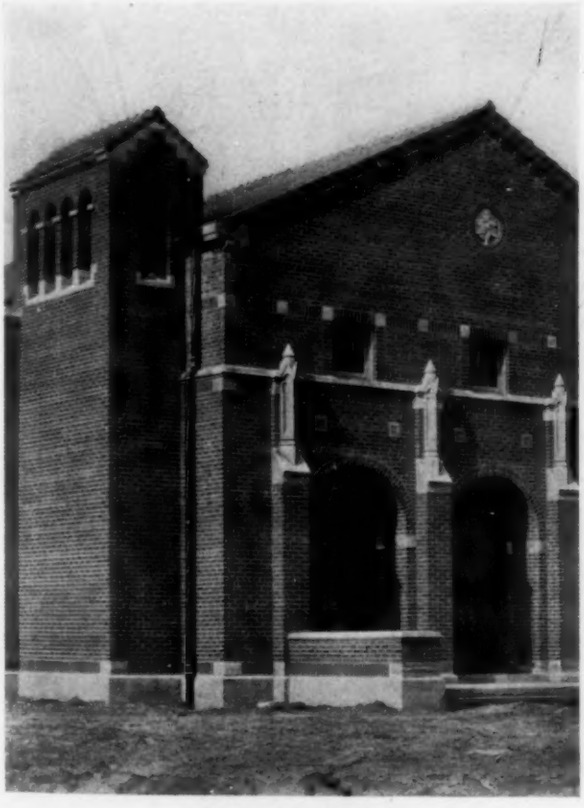


FIRST FLOOR

PLANS, MOREY JUNIOR HIGH SCHOOL, DENVER

WILLIAM E. AND ARTHUR A. FISHER, ARCHITECTS

PART OF MAIN FACADE



AUDITORIUM ENTRANCE

MAIN ENTRANCE

Plan on Back

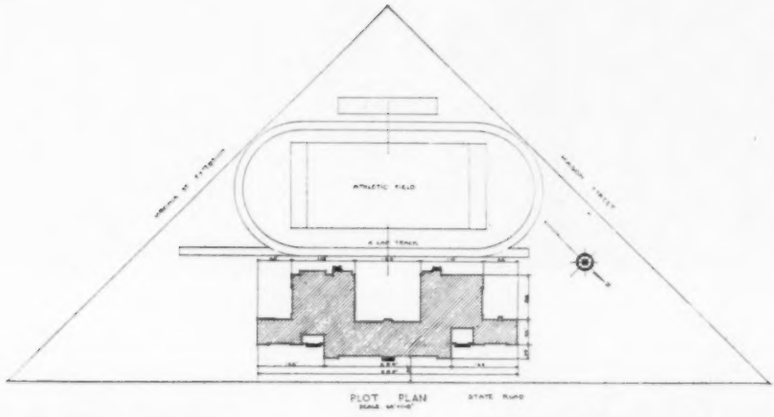
WILSON JUNIOR HIGH SCHOOL, APPLETON, WIS.

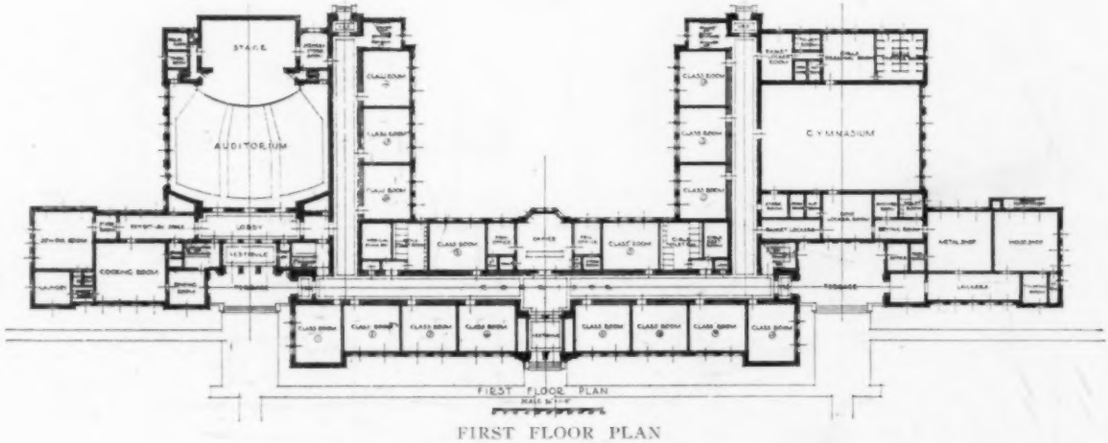
PERKINS, FELLOWS & HAMILTON, ARCHITECTS

COST AND CONSTRUCTION DATA

Sections of this school, designed to accommodate 600 pupils, were completed in September, 1924, at a cost of $294,-904, or 29.6 cents per cubic foot. The cost per pupil was about $491.50.

Tile and composition roofs were used in connection with brick exterior walls. The general construction is fireproof.

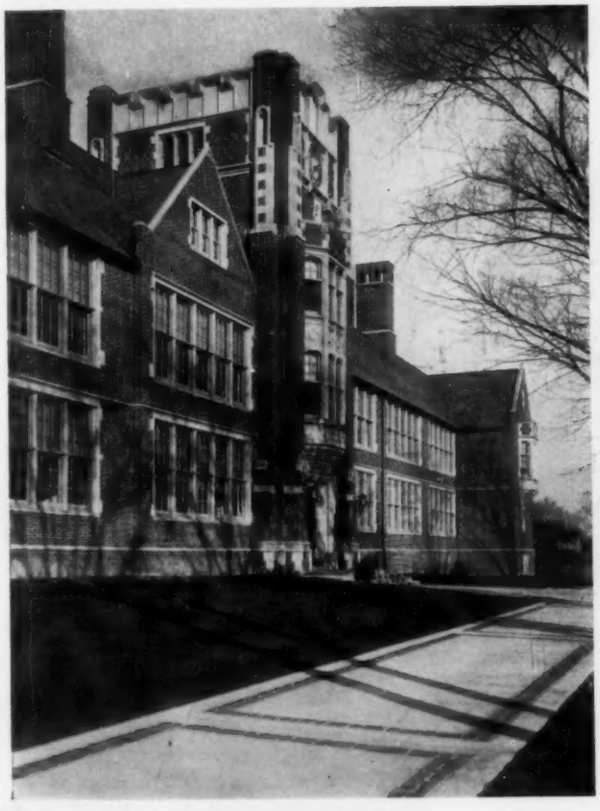




FIRST FLOOR PLAN

WILSON JUNIOR HIGH SCHOOL, APPLETON, WIS.
PERKINS, FELLOWS & HAMILTON, ARCHITECTS

GENERAL VIEW



PRINCIPAL FACADE

MAIN ENTRANCE

Plans on Back

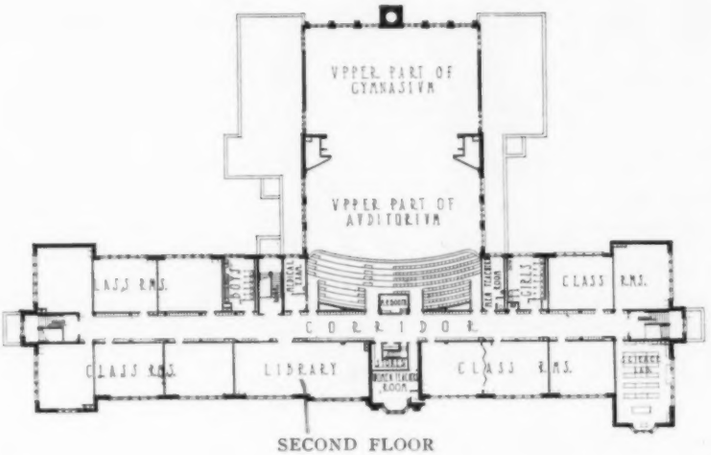
THADDEUS STEVENS JUNIOR HIGH SCHOOL, WILLIAMSPORT, PA.

GUILBERT & BETELLE, ARCHITECTS

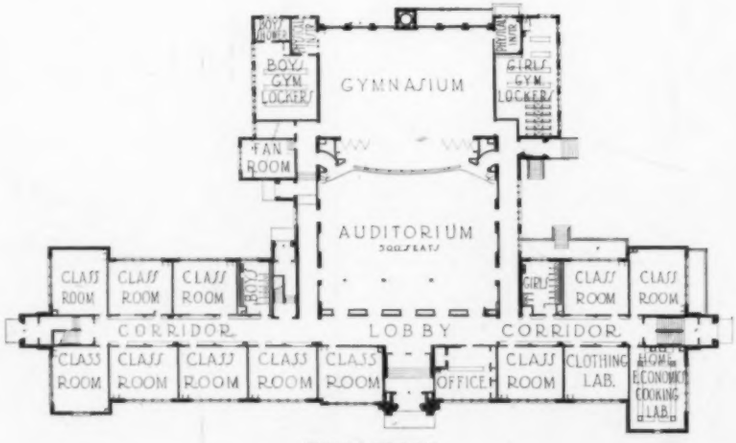
COST AND CONSTRUCTION DATA

Completed in August, 1927, this school cost $409,127, or 40.75 cents per cubic foot. The capacity is 983 pupils, making the cost per pupil about $406.

The construction is fireproof with brick and limestone exterior finish, and the flat roof is covered with a pitch and slag composition.



SECOND FLOOR



FIRST FLOOR

PLANS, THADDEUS STEVENS JUNIOR HIGH SCHOOL, WILLIAMSPORT, PA.
GUILBERT & BETELLE, ARCHITECTS

SOME NOTES ON JUNIOR HIGH SCHOOLS

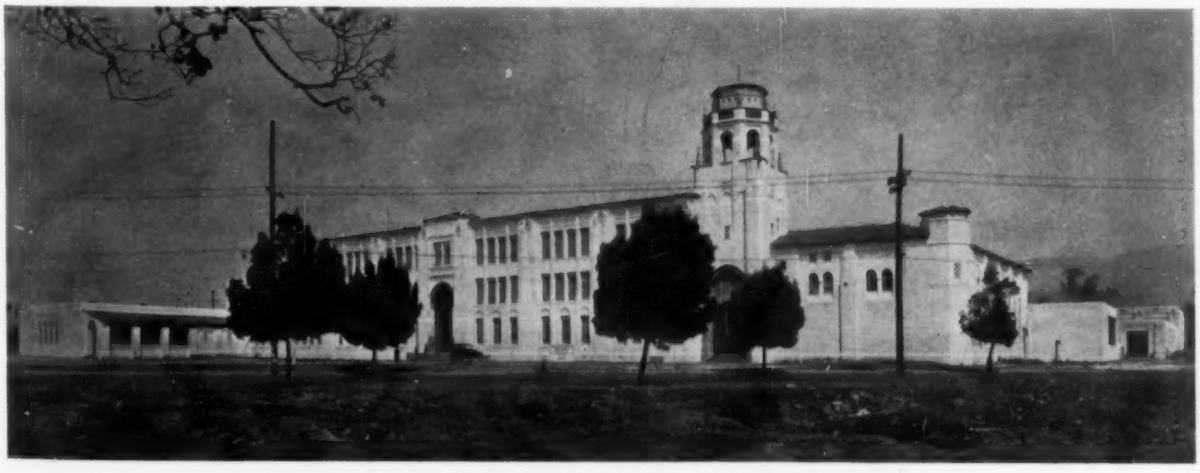
BY
R. CLIPSTON STURGIS, ARCHITECT

THE public knows that schools, both the buildings and the instruction, are costing more and more. Increases in teachers' salaries can be understood and accepted; the cost of the buildings cannot. The blame has been put on the architect and his demand for at least some expression of beauty. This article is to ask for more beauty and less cost in our schools, and to show that wasteful expenditure is in the plan, in the demands of popular pressure for needless rooms and equipment, and not in bricks and mortar, nor in decoration. As a matter of fact, in a school building, the amount that can reasonably be put into ornament either inside or out is a perfectly insignificant item in the total cost. This is a plea for more beauty in our schools.

To understand the problem of the junior high school, it is perhaps well to review the steps which led to the demand for this type of school. Before 1900 the generally accepted division of the 12 grades was eight elementary and four high. The elementary was usually divided into four lower elementary or primary and four upper elementary or grammar. In most eastern cities there was a principal in the grammar school, and he was the head of the primary schools in his district. In response to a general demand for some kind of industrial education in the elementary schools, classes were established in cooking and woodworking for the two upper grades. In the grammar school also was the hall, which was frequently put under the high roof, the most dangerous place in the building for a crowd.

Educators generally were interested in an experiment started at Gary, Indiana. The ideas there embodied were not altogether new, but they emphasized what many were thinking about,—the growing cost of schools; and this was one solution. It came naturally in a manufacturing town, and was the application to the schools of a commonplace of manufacturing,—that a plant should be run to its capacity in working hours, and that, as far as possible, all machines should be running all the time. The school was a costly plant. It was idle during vacations. That perhaps could not be helped; but parts of the school were idle part of every school session. The hall was generally unoccupied. The industrial rooms might be filled every school hour, but the desks of the pupils at work elsewhere were empty. The Gary idea was to arrange a schedule so that every room and the hall would be in use every school hour. I believe two sessions a day for two sets of scholars, and summer school also, were included in the plan to make the schools work every day, all day, and all the year. This is mentioned merely as indicative of the fact that citizens were beginning to question the increasing cost of schooling and schools, and educators were trying to answer their questions.

Before 1914 careful study had been made, in various parts of the country, of the requirements for the three types of school, lower elementary, upper elementary, and high, and an attempt to arrive at a standard of cost for each one of the three. This was done with some success for the elementary schools. The lower, with classrooms only and no principal, cost $140 per pupil. The upper elementary, with principal, hall and industrial rooms, as well as classrooms, cost $180. The high school was another matter. Its cost was from $400 to $600 and $700;—an enormous jump from the elementary. The worst of it was that there were an increasing number of pupils going on to high school, and as the teaching was equally expensive, the burden was becoming very heavy. One curious reason for the great cost of the high school was that the home-room system of the elementary was continued in the high,



Frick Junior High School, Oakland, Cal.
Blaine & Olson, Architects

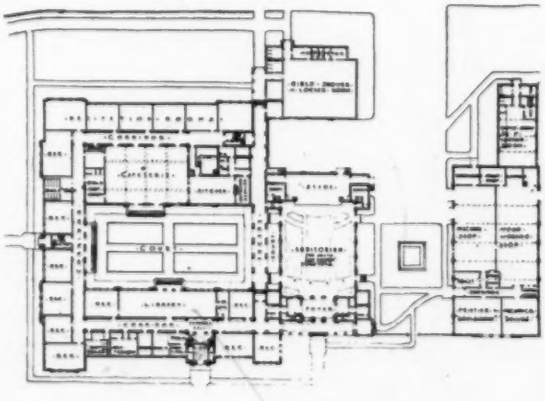
FRONT ELEVATION OF SCHOOL BUILDING

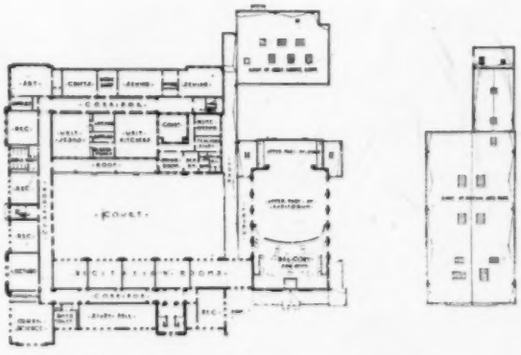
AUDITORIUM ENTRANCE

COST AND CONSTRUCTION DATA

This junior high school was built in 1922 at a cost of $340,000 or 20.9 cents per cubic foot. It will accommodate between 1200 and 1400 pupils and has equipment costing $50,000.

The interior partitions are of metal lath and plaster on wood studs, and the stairways are of fireproof construction. The exterior finish is stucco on masonry walls.

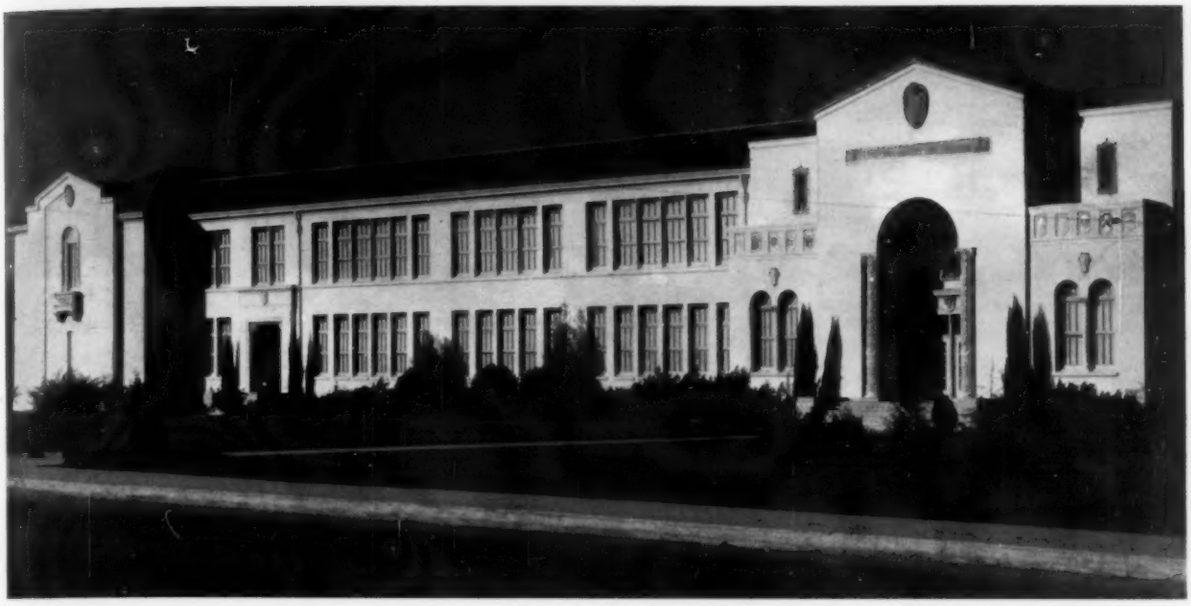




FIRST FLOOR SECOND FLOOR

THEODORE ROOSEVELT JUNIOR HIGH SCHOOL, SAN DIEGO

T. C. KISTNER & CO., ARCHITECTS

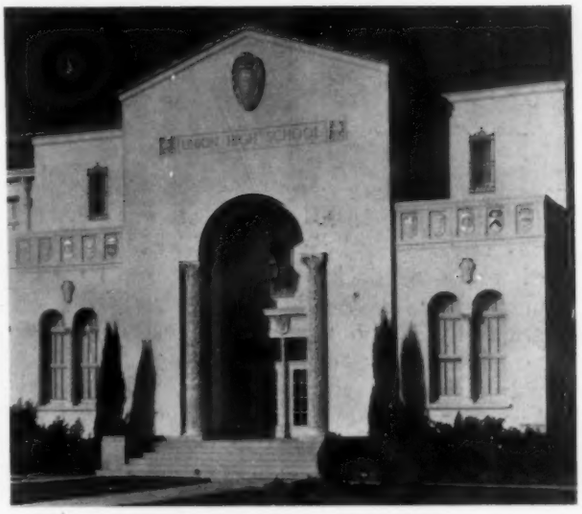


FRONT ELEVATION

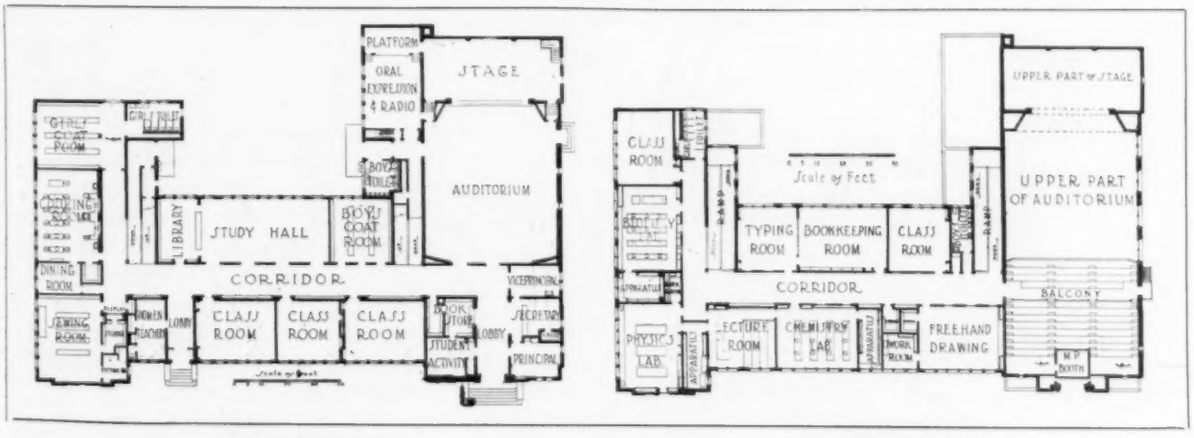
COST AND CONSTRUCTION DATA

Costing $198,700 or 24 cents per cubic foot, this school building was erected in 1924 to provide facilities for 400 students, making the cost per student about $497. Equipment costing $25,000 has since been installed.

The construction is reinforced concrete with an exterior finish of stucco, and the roof is of terra cotta tile. All corridors, ramps and stairways are of fireproof construction, and the interior trim is Douglas fir with hardwood doors.



DETAIL OF MAIN ENTRANCE



FIRST FLOOR SECOND FLOOR

MOUNTAIN VIEW UNION HIGH SCHOOL, SAN FRANCISCO

W. H. WEEKS, ARCHITECT

and every pupil had his 26-inch desk in his home room, which was vacant a good part of the time while the pupil was elsewhere, or occupied by some other pupil; whereas in the grammar, there were but two places outside the classroom where a pupil might be,—woodworking or cooking; in the high school there were half a dozen or more, so that the pupil was more often out of his room than in it. The obvious remedy was to do what was being tried at Gary, even in the elementary school,—make the rooms recitation rooms or study rooms, and let the pupils keep books etc. elsewhere. School authorities were loath to give up a system to which they were accustomed, and discussion was going on over the costly high school, when attention became focused on a solution which touched the elementary, as well as the high, and seemed not only logical but economical.

In the grammar, but two grades, seven and eight, had industrial work. The other two were educationally on the same basis as the lower elementary. Why not put these with the four lower grades in the less expensive building? If the first grade of high were withdrawn and put with grades seven and eight, one would have a school in which all grades would be taking industrial work, all would be about to change from the home room to the departmental recitation room, and the schedule could be so arranged that every room would be occupied at every period by a class. The hall might well serve as a place for physical exercise, for which there was now a general demand; so shops, hall and recitation rooms would be fully occupied. This school was the intermediate or junior high. It was to be the stepping stone between the elementary and the high. There would be no expensive science department, nor commercial, such as was in the high, and the hall would be simply a large room for physical exercise and occasional meetings. One has noted already the economy of putting grades five and six into elementary buildings. There was a further economy in putting grade nine into a building less expensive than the high school.

The problem before the architect then, was to built to fit these conditions. They were not new; it was nothing but the old grammar school with slightly increased industrial teaching and with the hall planned to serve as a gymnasium. It should have cost little more than the grammar. The figures quoted are pre-war figures. They had been practically constant for ten years. When school building was renewed after the war, communities had got accustomed to rising prices, and before we entered the war they were far above 1914 (150); but then they jumped unexpectedly and soared with all building to the peak in 1920 (250), and then slowly receded, until today the factor is two as compared with 1914. If we apply the factor of 250, to allow for added industrial equipment, to the 1914 prices, upper elementary $180, we get $450 for the junior high. The actual costs of the junior high, which have never been in any way stabilized any more than the requirements, have run from $400 to $700, and in cases even more, but the low figure represents a building in essentials nothing but the old grammar.

The taxpayer certainly has a right to inquire the reason of this and to ask if anything has been obtained equivalent to the cost. Hitherto it is the building cost alone that has been mentioned, but the teaching has also increased in cost and for the same reason. Miscellaneous industrial work of every description and larger and more elaborate auditoriums and gymnasiums have been demanded and provided in these junior high schools, which was never contemplated in the original plan. That was a simple but comprehensive plan of economy; the present junior high is an elaborate and expensive addition to the school plant, requiring more teachers as well as the expensive plant. It will be seen that many of the buildings here shown provide gymnasiums in addition to halls and sometimes two, for boys and girls, and dressing rooms and showers are provided. Whether or not all this equipment is required is not a question for the architect. He is not supposed to know the educational end of the problem but merely to provide the rooms required. It is thus that the new elaborate and costly buildings have grown. It is an ungracious, as well as unprofitable task, for an architect to point out to his employer how to economize, and yet the architect is the only one who knows enough about the economy of planning to be able to lead the community to a clear understanding of the subject of school costs; and if by wise economies in the plan he can save for the beauty of his building, it is certainly time well spent.

At the risk of repeating what architects already know, there might be mentioned two fundamental factors in the economy of planning a school building: (1) Have no area larger than is required for its purpose, and of course no area that is useless. (2) Have no unnecessary height. This results in a compact plan, in both area and cube. It seems at first sight simple to follow these rules. It is not. School authorities will often determine the sizes of rooms, and a study of the requirements of the rooms, with a view to modifying the dimensions, is neither required nor allowed. Needless area is often provided due to this. At the time when sizes of classes were reduced (from 56 to 42), many teachers urged that the sizes of rooms should be retained, nor did it occur to the educational authorities that a building with 500 children in 12 rooms would cost more than one housing them in ten rooms. One of the most fruitful sources of waste was in corridors. On the theater principle, corridor widths are determined by the numbers using them. Applying this, quite wrongly, to schools, regulations fixed legally the minimum width of corridors. The children file out, and a corridor in excess of what is necessary for two double files is not only wasteful but dangerous as likely to cause disorder. The same thing applies to stairs. It would have been more reasonable if the law had limited the width and fixed the maxi-

mum, but better still if such matters were not put on the statute books, to become obsolete or ridiculous. Some of the legal requirements about air have no longer a semblance of any relation to health.

One touches on these things because in many cases the casual citizen seeing a school of some architectural beauty at once concludes that it is this, to him useless or at least unnecessary beauty, which is making the costs of schools mount. It is nothing of the kind. The cost is due to what is in the building, the wastefulness of its plan, its elaborate and costly equipment of halls whose use, by the schools, hardly justifies the expense; the gymnasiums for boys and girls, baths, and swimming pools. Consider for a moment the baths. The ordinary physical exercises are school routine, and in many places at least are not such exercises as require a complete change of clothes or a bath. In such schools the bath equipment need be only sufficient for athletic teams. Even here the girls' equipment is costly, as girls are not expected to bathe or dress together, and must have individual dressing rooms and lockers.

There is often no standard in a state, or even in a city, as to what industrial equipment should be provided. One school will have two or three classroom units for the boys' and about the same for the girls' industrial; another will have double this amount. One expects to find the second a larger school, but often it turns out to be smaller. It is, or should be, obvious that these industrial class subdivisions should be in a definite ratio to the number of pupils in the school, as a half-class generally is the standard in an industrial room. In the same way the capacity of the hall would be in proportion to the size of the school, to seat half the school, or the whole; to take double units or single on the floor for exercises, and so a standard would be established. If the hall is to be used by the town or city as a general auditorium, it is hardly fair to build it at the cost of the school appropriation. The school use alone would not justify the large halls here shown. Again the gymnasium. It is ideal to have a hall and separate gymnasium for boys and girls. If the building accommodates 3,000 to 4,000 pupils, such equipment is justified. If the building has less than 1,500, perhaps one gymnasium would have to serve. If 1,000 or less, a combined assembly hall and gymnasium would seem the reasonable limit.

A glance at the plans of junior high schools illustrating this article and in the foregoing plate section will show exactly what is meant. The Stevens, Glens Falls, the Lincoln and Kearney schools are more or less the same size. The Stevens has for hall and gymnasium 73 x 120, the Glens Falls 80 x 130, the Lincoln 70 x 120, Kearney 80 x 144. Not even the smallest of these is justified by the size of the school or needed for school purposes. Some have assembly hall and gymnasium combined, using a deep stage for the gymnasium. The hall is not available when the gymnasium, behind a movable partition, is in use, and the stage, provided by opening this partition, is useless in size. Kearney takes this overgrown stage for the boys and then has another gymnasium over the cafeteria for the girls. Glens Falls has a very large dressing room and bath equipment and swimming pool, which the others have not. There is no standard, and this one unit in all these plans is the large item in expense. California is lucky. All this is done out of doors. A couple of one-story locker and bath buildings and the open air,—and the gymnasium problem is solved.

On the next count, industrial equipment, there is still less correspondence. The Fall River School has perhaps the largest, with wood working, metal working, drawing, printing, textiles, etc. for boys; and sewing, millinery, cooking, household science and drawing for the girls; a general science and special music room and library as well.

As against this at the other extreme, the Thaddeus Stevens has a shop for boys, two for girls and a science room,—hardly more than would have gone into a grammar school of this size 20 years ago. The Glens Falls school seems more like a town hall, with a few classrooms added as an afterthought. If the plans of Glens Falls and Fall River are put side by side, one cannot believe them to be solutions of the same problem. Still both are called "junior high."

The North Park Junior High was planned for by a superintendent and school committee who knew just what educational end they were aiming for in Fall River. It may not apply anywhere else, and it may not be the solution of a junior high. It is at least a genuine attempt to obtain junior high accommodation without extravagance. A brief description may be of value. Of the three grades, about 400 each to be housed, the seventh was put in home rooms with wardrobes, the other two, eight and nine, had lockers for books, and were on the departmental system, going to recitation rooms. The hall was arranged so that the floor clear of the galleries was large enough for 70 to exercise; and chairs, in place elsewhere, would provide for morning service. The expense of baths and lockers was definitely faced and accepted, and the boys and girls have a period long enough to include a bath. Two other exercising spaces were provided,—one on the hall roof, and one in the enclosed and paved courtyard. Unusual and costly features were included to meet definite demands,—a public library branch, an extra small hall, and a good sized music room. The cost of these does not really belong to the school. Otherwise it is a junior high where the amount of industrial equipment is justified by its location in a mill town.

To complete the comparison, this is the cost per pupil in Thaddeus Stevens, North Park, the Lincoln and Glens Falls;—The Thaddeus Stevens accommodation is 915, cost $409,127, $450 per pupil. The North Park accommodation is 1200, cost $685,000, $570 per pupil. The Lincoln accommodation, 780, cost $410,000, $520 per pupil. The Glens Falls accommodation, 890, cost $360,000, $400 per pupil.

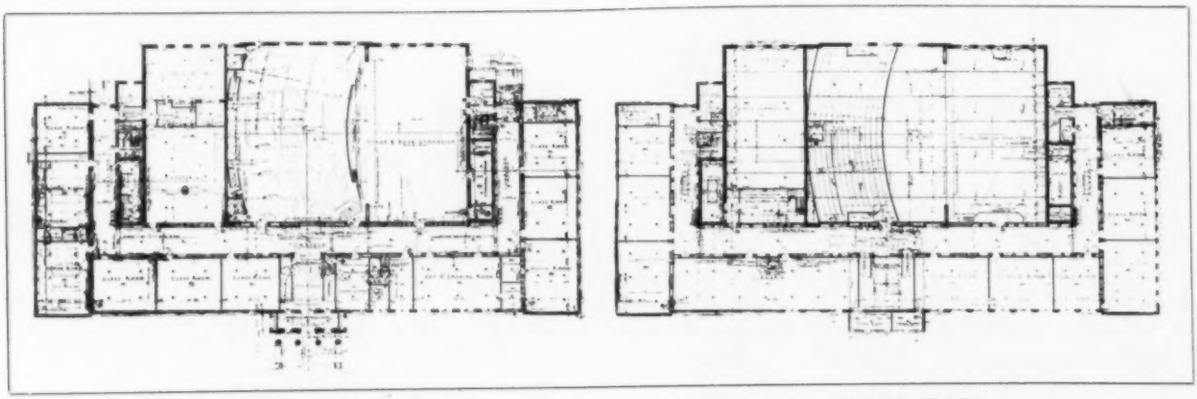
GENERAL VIEW

ENTRANCE PORTICO

COST AND CONSTRUCTION DATA

This high school building was completed in December 1925 at a cost of $216,000, or 20.4 cents per cubic foot. The cost of equipment installed in the building was $20,000, and it is designed to accommodate 750 pupils, making a cost per pupil of $288.

All corridors, classrooms and stairways are of fireproof construction. The roof structure is of wood, and the interior finish is of oak with oak floors in the classrooms. The exterior walls are of face brick with stone trim.



FIRST FLOOR SECOND FLOOR

HIGH SCHOOL, KEARNEY, NEB.

DAVIS & WILSON, ARCHITECTS

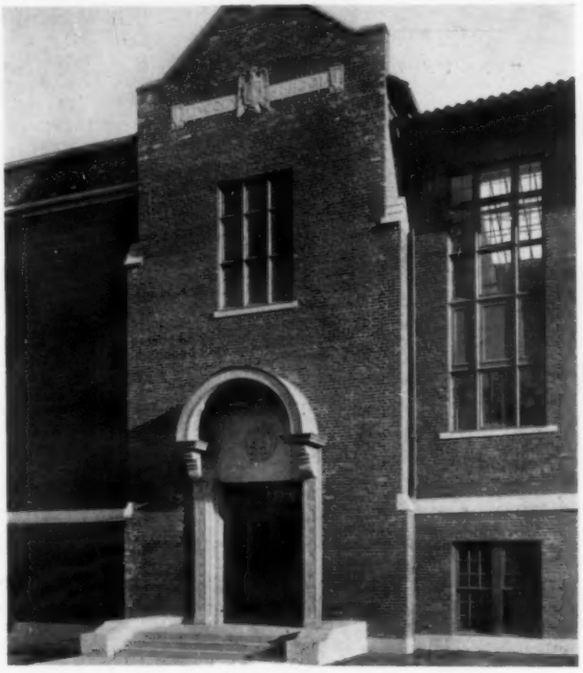
GENERAL VIEW

COST AND CONSTRUCTION DATA

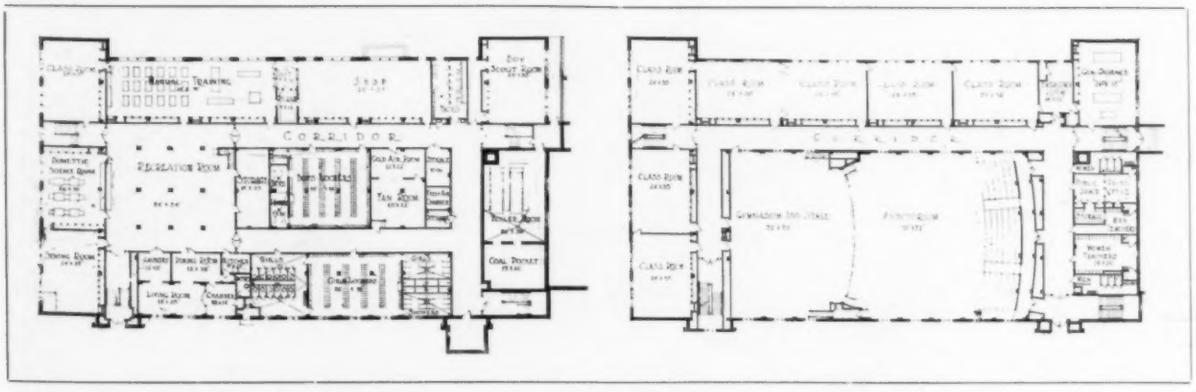
Completed October 1, 1925 at a cost of $409,667 or 37.7 cents per cubic foot, this school building has a capacity of 900 pupils, making a unit cost of about $455. The cost of the equipment installed was $24,136.

The exterior walls are of waterstruck brick, and the pitched roofs are of red Spanish tile, while the flat roofs are covered with tar and gravel composition.

The interior is of fireproof construction as regards floors, corridors and stair towers.



MAIN ENTRANCE BAY



BASEMENT FIRST FLOOR

LINCOLN JUNIOR HIGH SCHOOL, MALDEN, MASS.

JAMES H. RITCHIE & ASSOCIATES, ARCHITECTS

The accommodations given here are not what were given by the architects,—some are higher, some lower. There are many ways of taking off accommodations in a junior high, and some of these returned by the architects were so obviously low, while others were obviously high, that it seemed fairer, if a comparison were made, to take them off on the same basis; namely, full quota for classrooms, half units for the industrial rooms, and double classroom unit for the gymnasiums. All these have cost the tax payers about the same per pupil, but in some cases the town has paid for a hall and in others for a school.

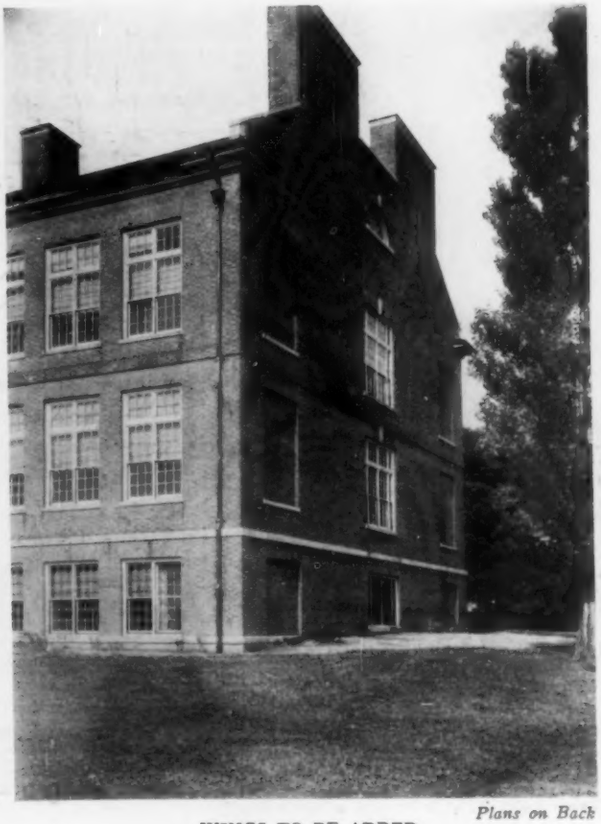
One has attempted to prove for the sake of the schools, for the sake of the tax payer, and for the sake of the community, that it is not architectural beauty, either within or without that caused the high cost of such schools as these, but the inclusion of costly space or equipment. There is nothing more vital in the life of the child than being surrounded by beauty. The Thaddeus Stevens school must leave its impress consciously or unconsciously on the children. Although the designer of a school building is somewhat hampered by the necessities of light, that is the architect's opportunity, and our many good buildings are sufficient evidence that the schools can be made fine examples of design. Not sufficient emphasis has been placed on the beauty desirable in the interior. Classrooms have been cursed by the necessary blackboards; one believes that a needless amount has been demanded everywhere; but surely in the junior high the recitation room, under the guidance of its teachers of English or of geography, might well be made a room that would be more like a charming home study or library than a classroom.

Editor's Note.—It is of little use for architects to practice economy in the preparation of their specifications and in their plans and elevations for school buildings if politicians are going to influence and control the selection of contractors; and too often it happens that contracts have been let on carefully planned and specified buildings for definite amounts of money and appropriations of sufficient amounts made by municipal governments, only to have costs tremendously increased during the progress of the work by so-called "extras" claimed by politically subsidized contractors. Often have thousands of dollars in pure graft been added to the costs of school buildings on the pretext of including extras, which are usually unjustly charged to the oversight of the architects. Graft-ridden communities can never expect to get the full value of money expended on schools and town halls.

Brimmer School for Girls, Boston
R. Clipston Sturgis, Architects

Photos. Frances Benjamin Johnson GENERAL VIEW

CORRIDOR ENTRANCE



WINGS TO BE ADDED

Plans on Back

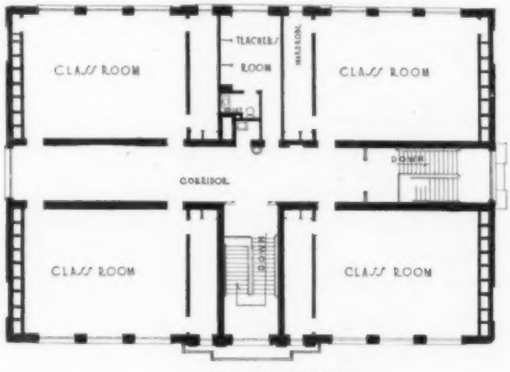
WASHINGTON GRADE SCHOOL, SOUTH MANCHESTER, CONN.

FRANK C. FARLEY, ARCHITECT; WILLIAM HARMON BEERS, ASSOCIATE ARCHITECT

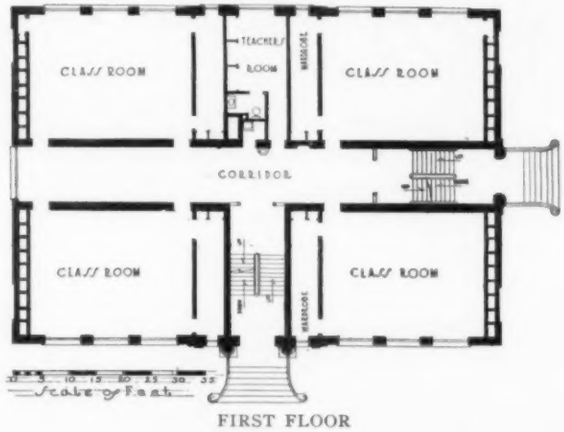
COST AND CONSTRUCTION DATA

Having a capacity of 360 pupils, kindergarten to eighth grade, this school was built in 1915 at a cost of about $55,000 or about 19 cents per cubic foot.

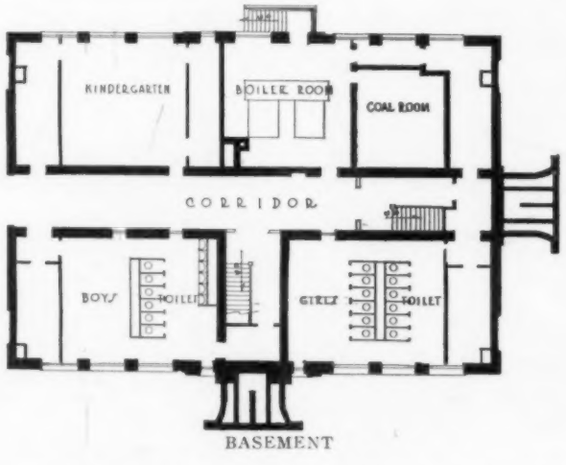
It is constructed of common brick with cast stone trim and slate roof. The floors are of reinforced concrete, and the roof structure consists of steel trusses and wood rafters.



SECOND FLOOR

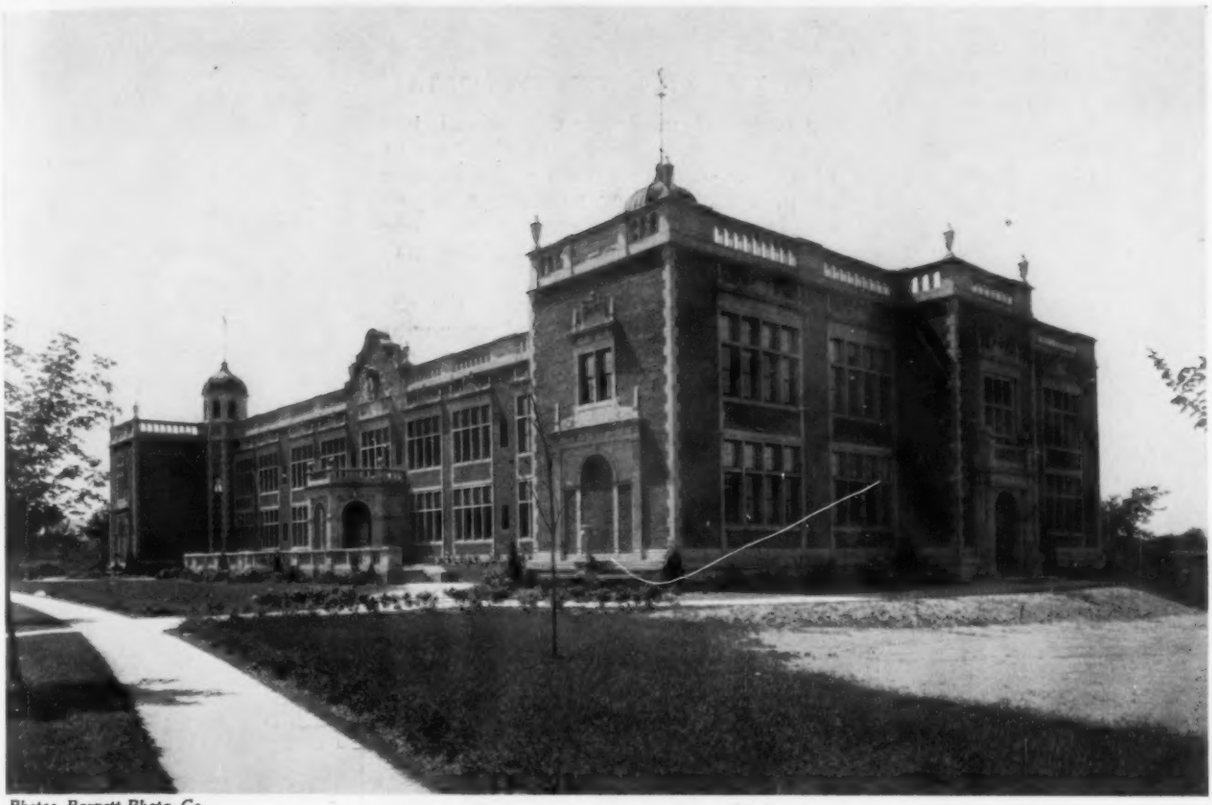


FIRST FLOOR



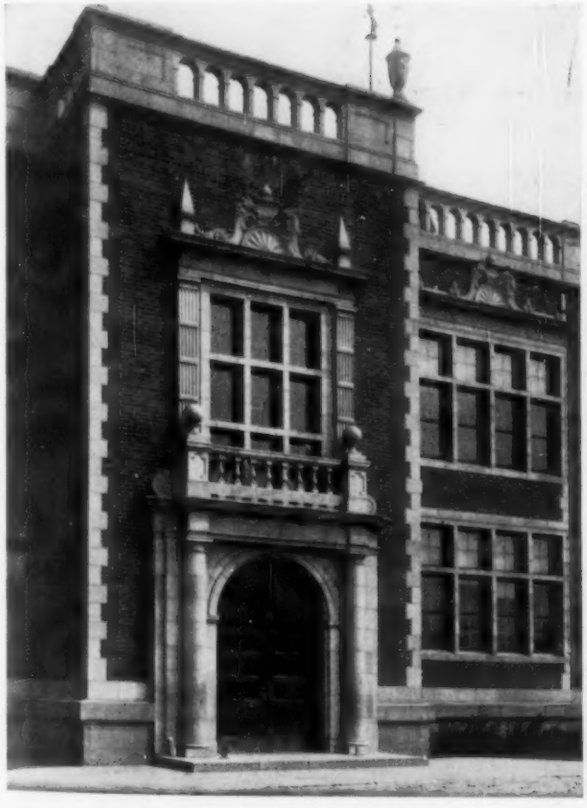
BASEMENT

PLANS, WASHINGTON GRADE SCHOOL, SOUTH MANCHESTER, CONN.
FRANK C. FARLEY, ARCHITECT; WILLIAM HARMON BEERS, ASSOCIATE ARCHITECT



Photos. Barrett Photo. Co.

GENERAL VIEW FROM THE WEST



SOUTH ENTRANCE

MAIN ENTRANCE

Plans on Back

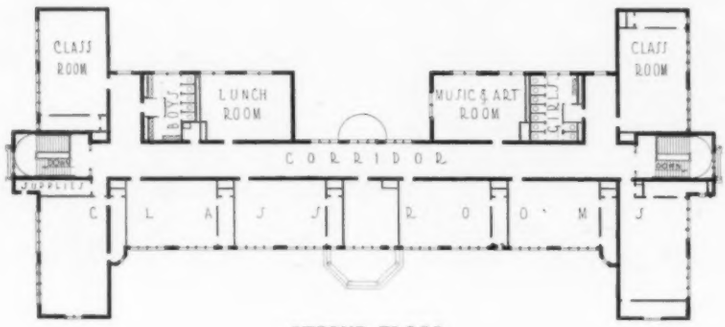
BOULEVARD SCHOOL, CLEVELAND HEIGHTS, OHIO

WARNER, McCORNACK & MITCHELL, ARCHITECTS

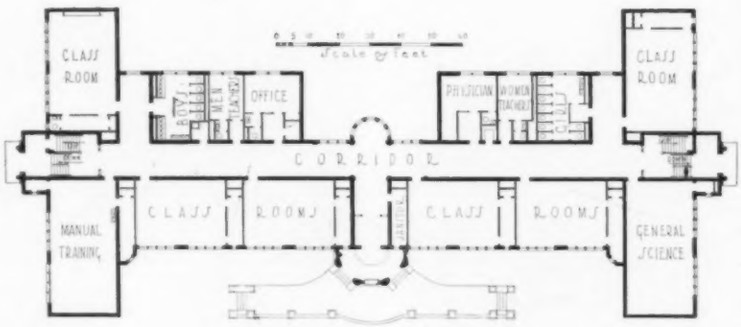
COST AND CONSTRUCTION DATA

Completed in 1924, this school was built to accommodate 570 pupils at a cost of $267,379, not including the heating plant, gymnasium or auditorium, which are in separate buildings nearby. The cubic foot cost of the main building was 56 cents.

The construction is fireproof, the exterior walls being of brick and stone with terra cotta trim. The roof is covered with a composition of tar and gravel.



SECOND FLOOR



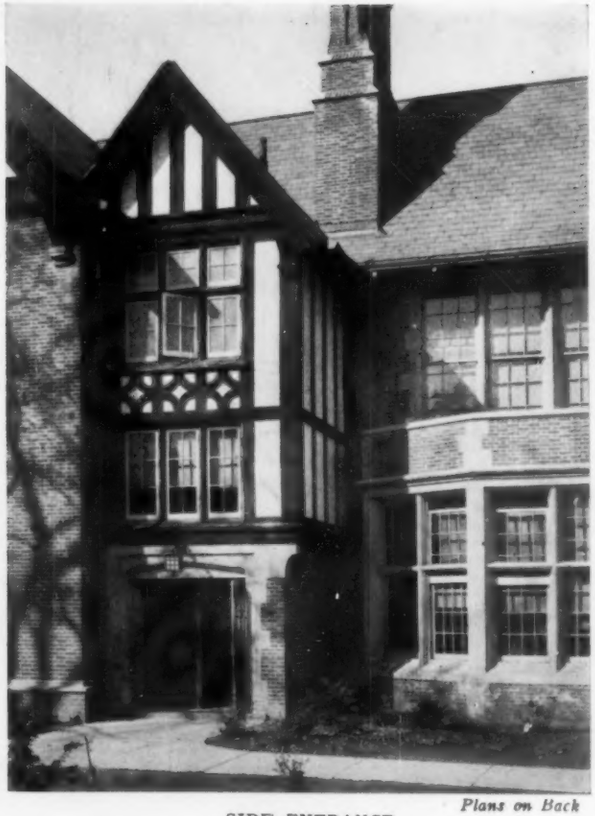
FIRST FLOOR

PLANS, BOULEVARD SCHOOL, CLEVELAND HEIGHTS, O.

WARNER, McCORNACK & MITCHELL, ARCHITECTS

GENERAL VIEW, REAR ELEVATION

FRONT FACADE



SIDE ENTRANCE

Plans on Back

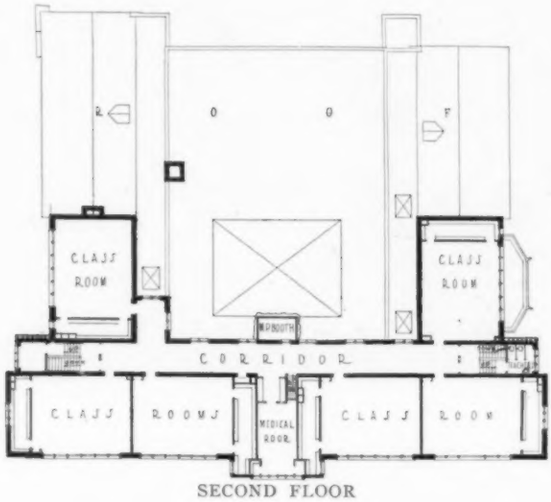
TUSCAN ROAD SCHOOL, MAPLEWOOD, N. J.

GUILBERT & BETELLE, ARCHITECTS

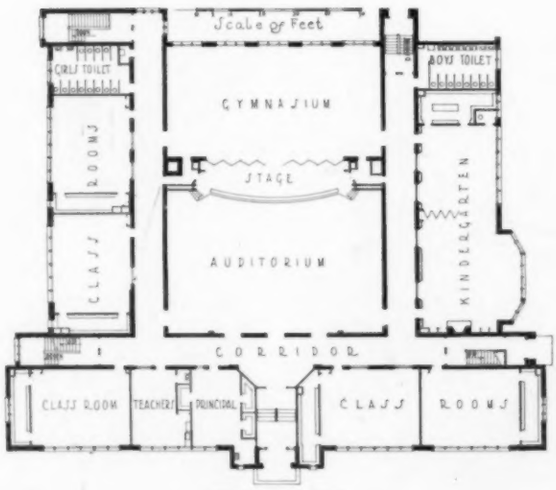
COST AND CONSTRUCTION DATA

Built to accommodate 660 pupils, this building cost $281,782 or 41.75 cents per cubic foot and was completed in 1925.

It is of slow-burning construction and has an exterior finish of brick with limestone trim. The sloping roofs are covered with slate, while the flat roofs have a pitch and slag composition covering.



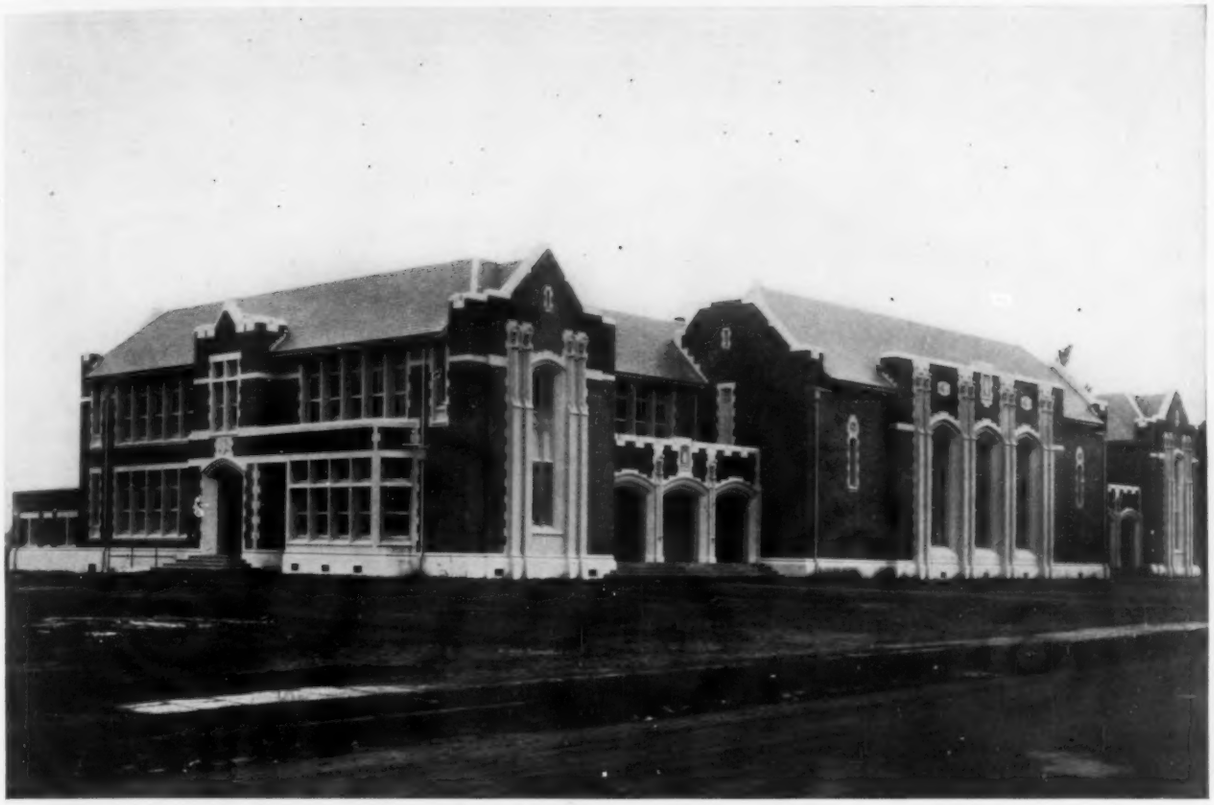
SECOND FLOOR



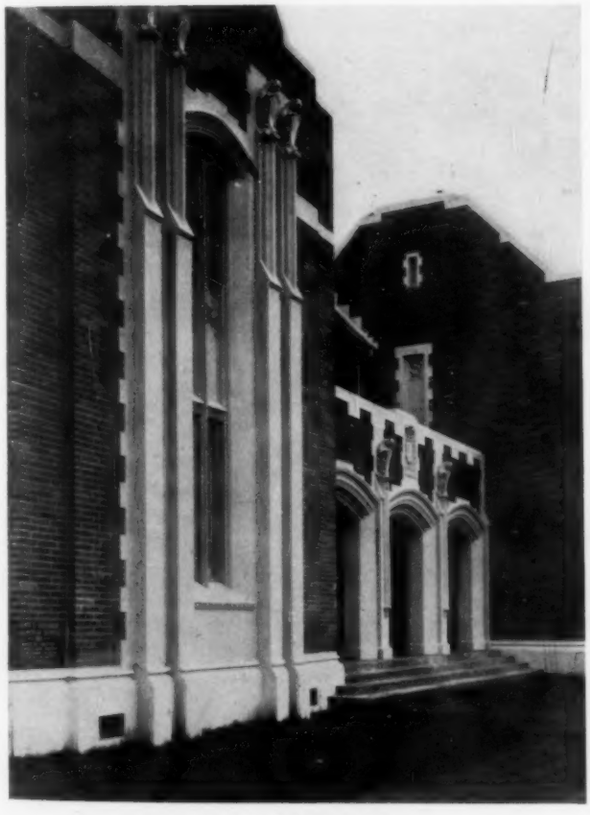
FIRST FLOOR

PLANS, TUSCAN ROAD SCHOOL, MAPLEWOOD, N. J.

GUILBERT & BETELLE, ARCHITECTS



GENERAL VIEW



DETAIL OF END BAY

CENTRAL PAVILION

Plans on Back

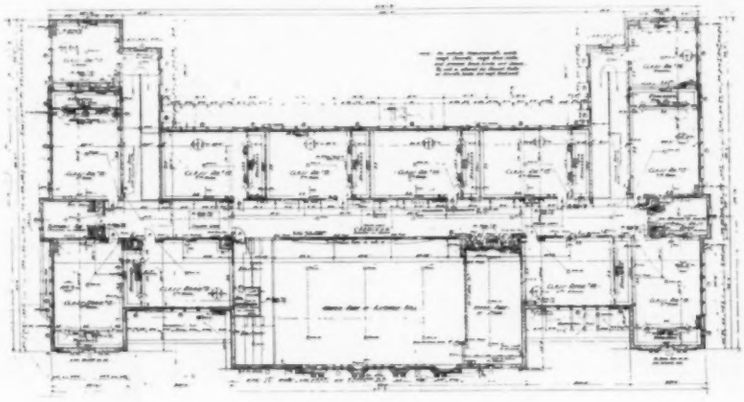
JOHN L. SHEARER GRAMMAR SCHOOL, NAPA, CAL.

W. H. WEEKS, ARCHITECT

COST AND CONSTRUCTION DATA

This school was finished in 1923, being planned to accommodate 550 students at a total cost of $152,000 or 21.5 cents per cubic foot.

The construction is fireproof, the exterior being of pressed brick with terra cotta trim and slate roof.



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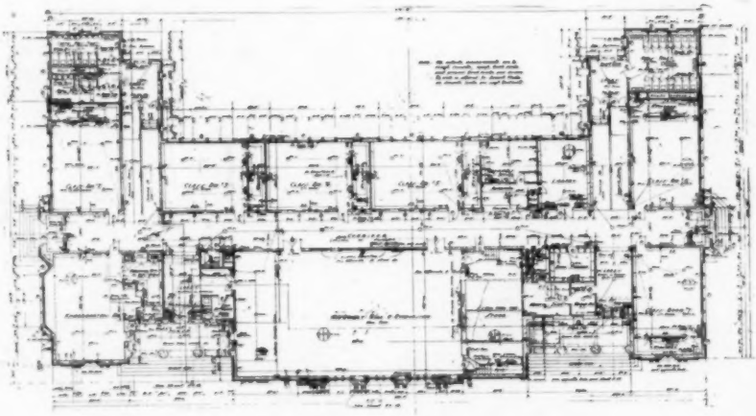
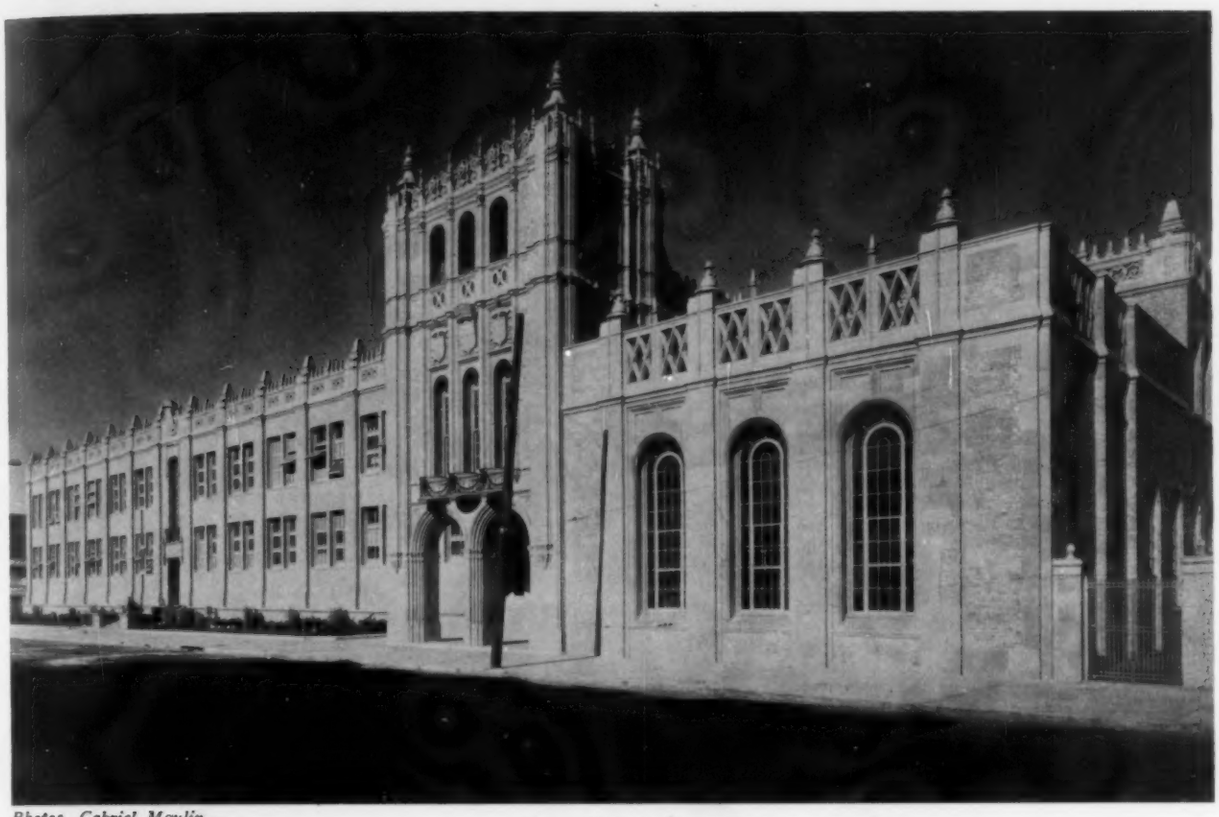


FIRST FLOOR

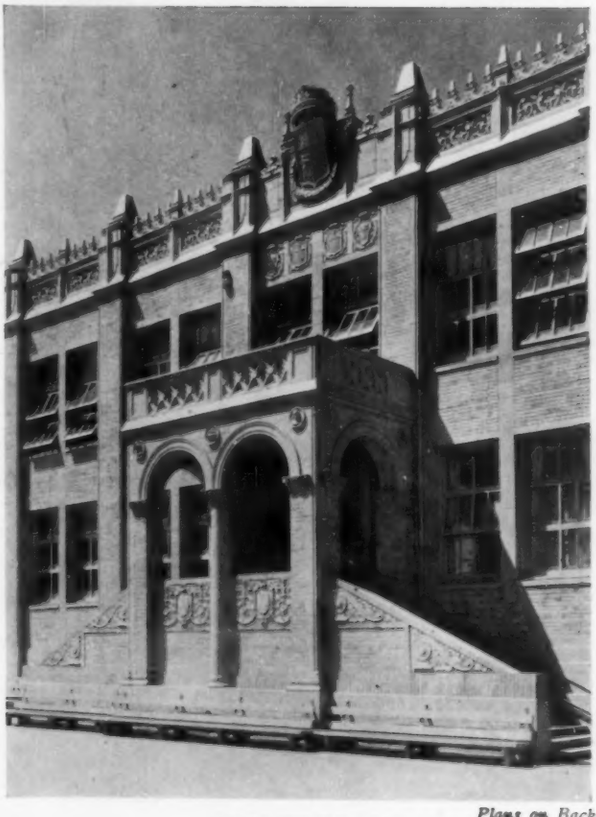
PLANS, JOHN L. SHEARER GRAMMAR SCHOOL, NAPA, CAL.
W. H. WEEKS, ARCHITECT



Photos. Gabriel Moulin

FRONT ELEVATION

YARD LOGGIA



YARD ENTRANCE

Plans on Back

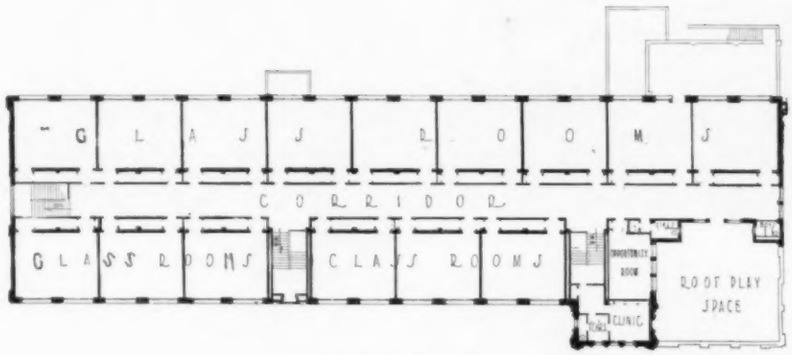
ALAMO SCHOOL, SAN FRANCISCO

J. R. MILLER & T. L. PFLUEGER, ARCHITECTS

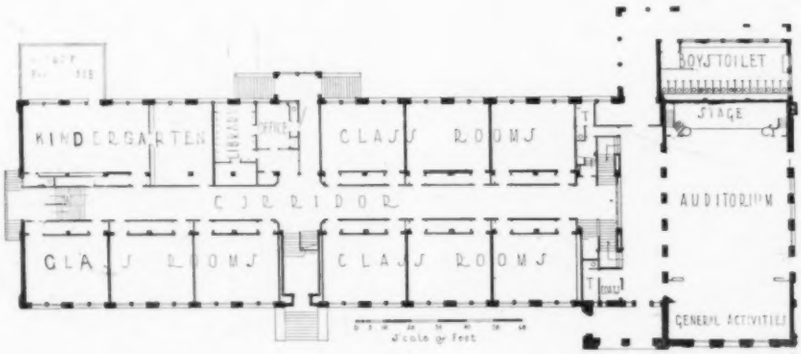
COST AND CONSTRUCTION DATA

This building was built to accommodate 1000 pupils and was completed in October, 1926 at a total cost of $371,661.51, making the cost per pupil $371.66. The equipment cost was $6,300, and the cubic foot cost of the building 38 cents. Owing to difficult physical conditions incident to this particular site and plan, these figures do not furnish a fair comparison with other similar work.

The construction is fireproof, being of concrete with steel frame, concrete floor and roof slabs, and stud partitions covered with metal lath and plastered, The exterior finish is brick and terra cotta, and the roof is covered with composition.



SECOND FLOOR



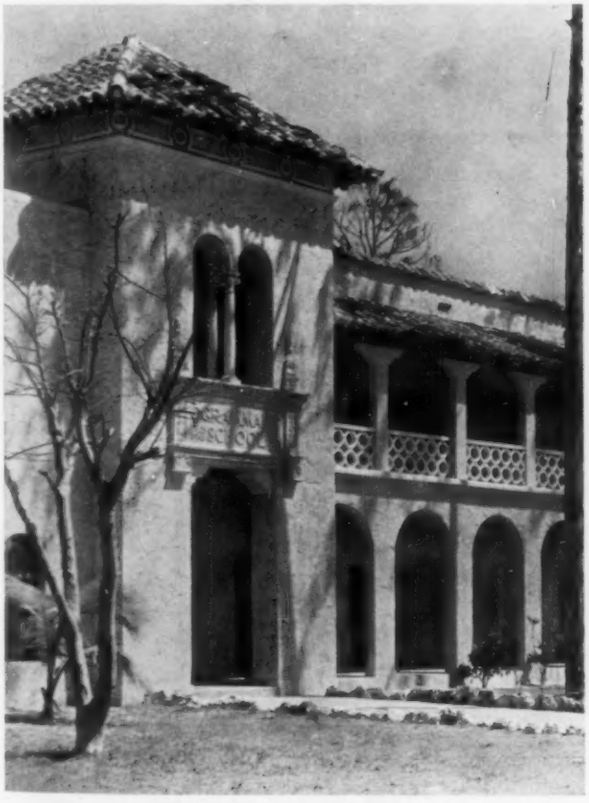
FIRST FLOOR

PLANS, ALAMO SCHOOL, SAN FRANCISCO

J. R. MILLER & T. L. PFLUEGER, ARCHITECTS

Photos. Richard B. Hoit

GENERAL VIEW



ENTRANCE DETAIL

SIDE ENTRANCE DETAIL

Plan on Back

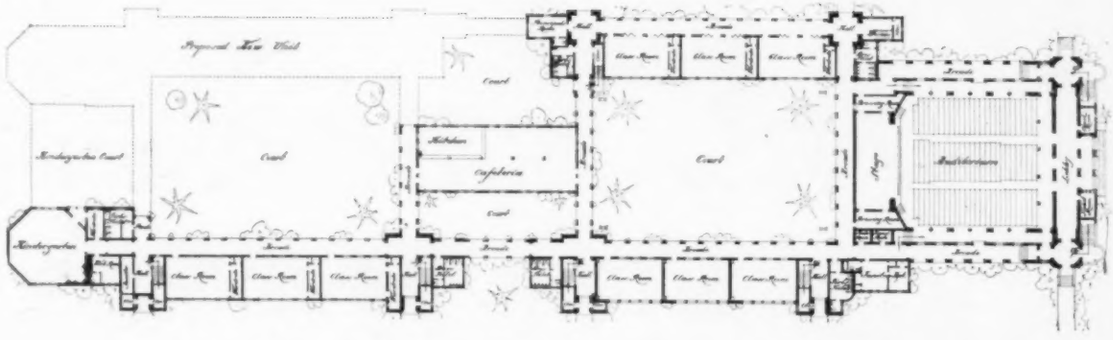
CORAL GABLES ELEMENTARY SCHOOL, CORAL GABLES, FLA.

KIEHNEL & ELLIOTT, ARCHITECTS

COST AND CONSTRUCTION DATA

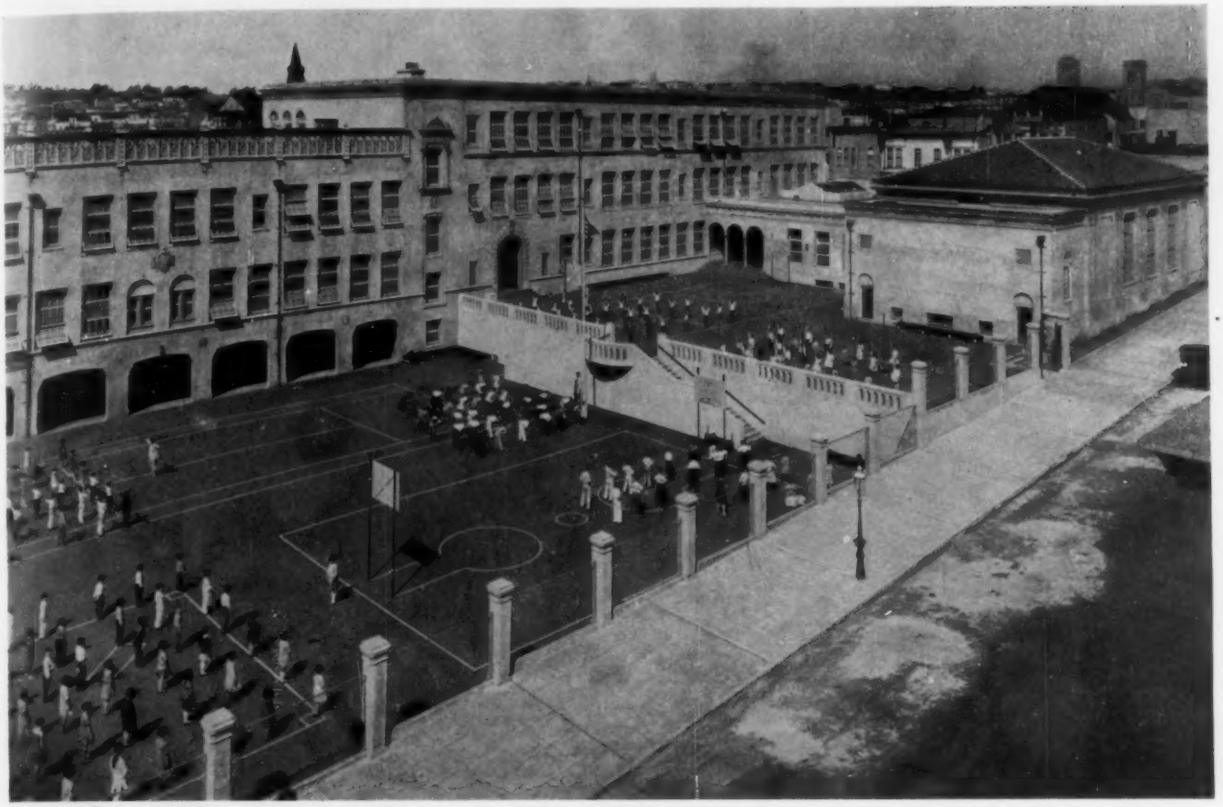
Completed in September, 1926 at a cost of 35 cents per cubic foot, this school accommodates 700 pupils. The total cost of the equipment was $22,000.

The walls are of masonry, and the roof is of wood construction covered with tile. The corridors on the first and second floors are of fireproof construction.

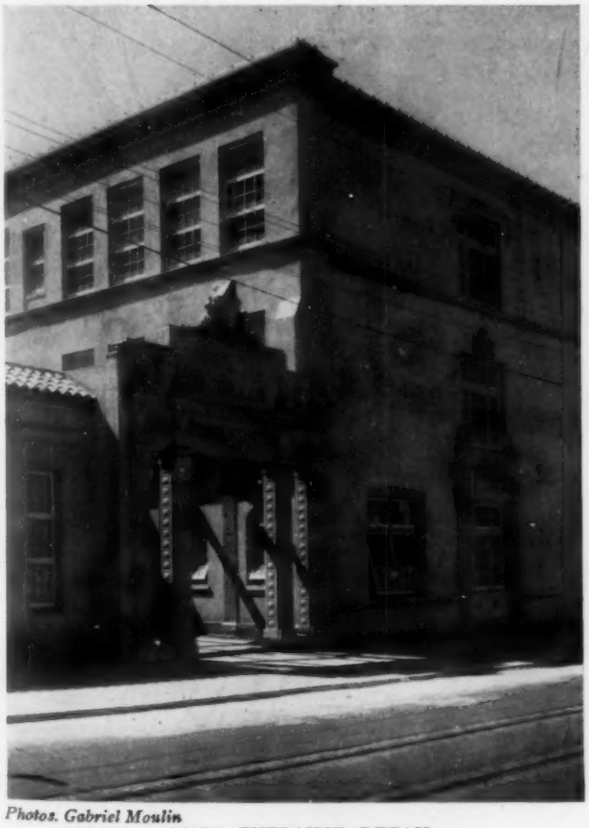


PLAN, CORAL GABLES ELEMENTARY SCHOOL, CORAL GABLES, FLA.

KIEHNEL & ELLIOTT, ARCHITECTS



EAST ELEVATION SHOWING PLAYGROUNDS



MAIN ENTRANCE DETAIL

INTERIOR OF AUDITORIUM

Photos. Gabriel Moulin *Plans on Back*

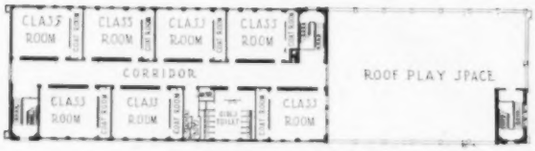
RAPHAEL WEILL SCHOOL, SAN FRANCISCO, CAL.
FREDERICK H. MEYER, ARCHITECT

COST AND CONSTRUCTION DATA

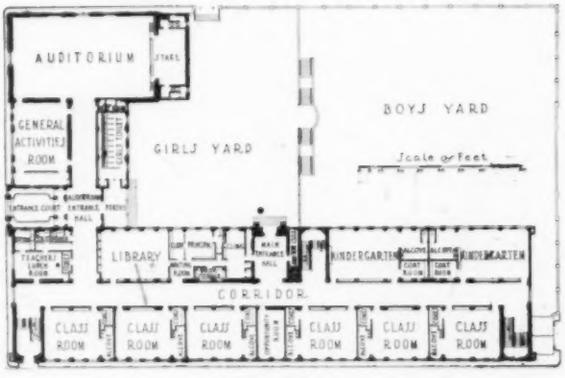
This school was completed in February, 1927 at a total cost of $358,990 and is planned for 1100 pupils, making the cost per pupil $326.35 and the cubic foot cost 35.9 cents.

The cost of equipment was $6,800 or $6.20 per pupil.

The building is of reinforced concrete construction with stud partitions. The stairs are of concrete and are enclosed in fireproof concrete towers. The interior trim is Oregon pine, stained brown.



THIRD FLOOR



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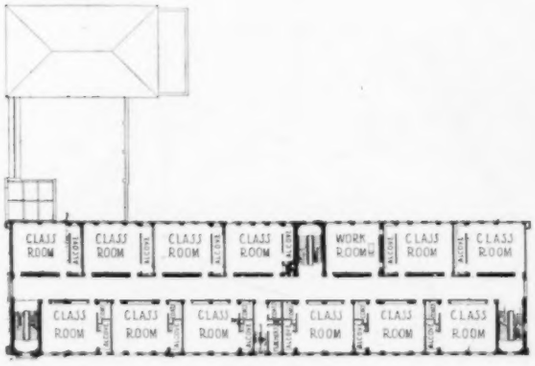
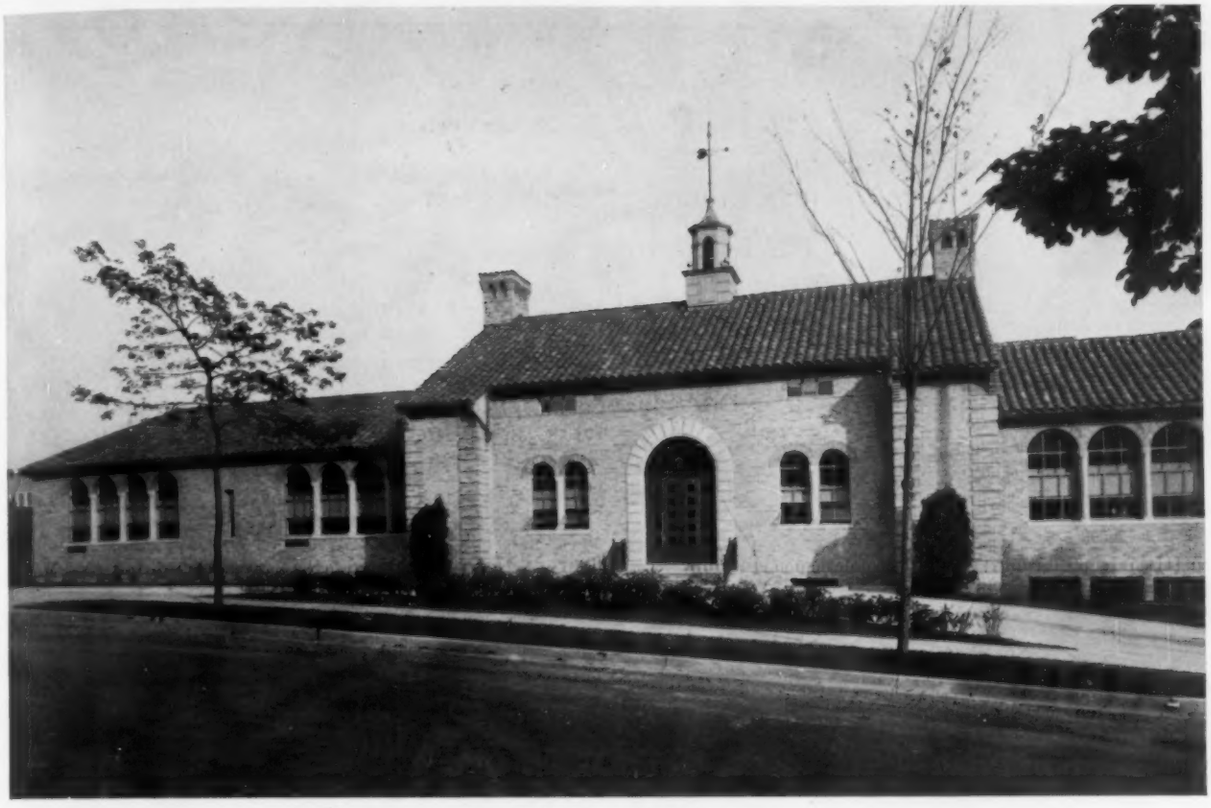


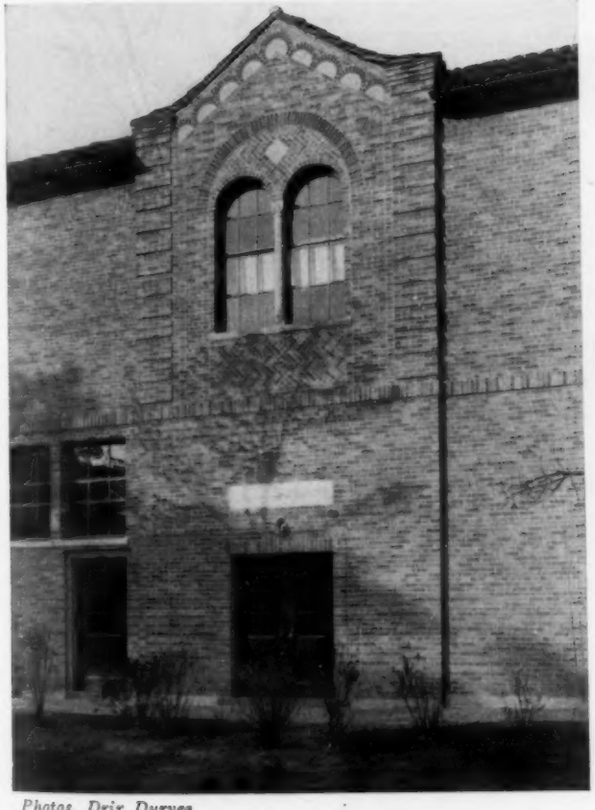
SECOND FLOOR

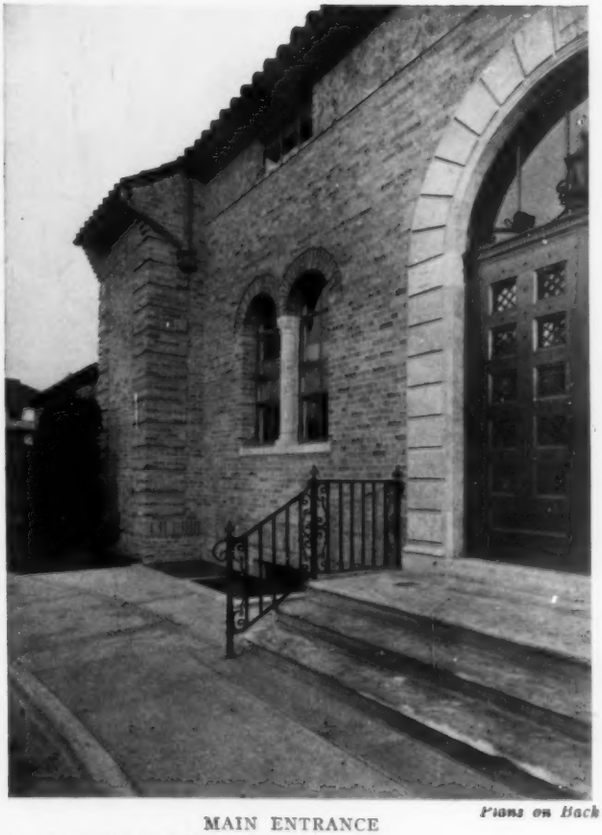
PLANS, RAPHAEL WEILL SCHOOL, SAN FRANCISCO

FREDERICK H. MEYER, ARCHITECT



FRONT ELEVATION





Photos. Drix Duryea *Plans on Back*

SIDE ENTRANCE MAIN ENTRANCE

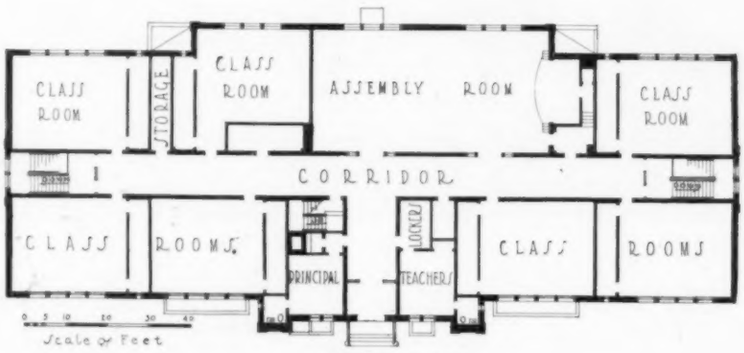
CENTRAL GRADE SCHOOL, GLEN RIDGE, N. J.

GOODWILLIE & MORAN, ARCHITECTS

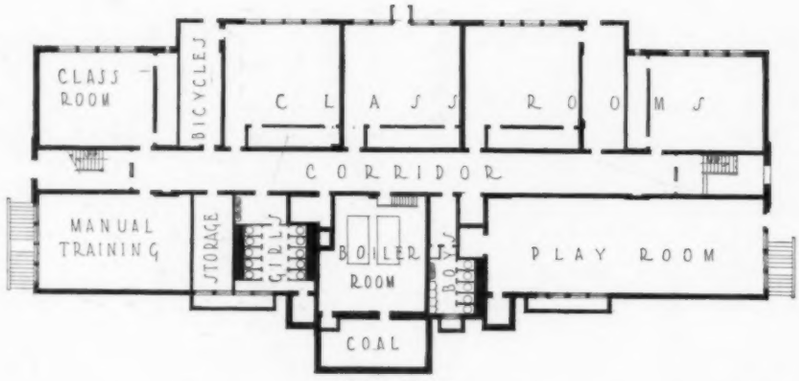
COST AND CONSTRUCTION DATA

At a total cost of $189,000 or 48 cents per cubic foot this school was completed in March, 1925. The number of pupils to be accommodated is 420, making a cost per pupil of $450.

The exterior walls are of brick and cinder concrete with tile backing. The floors are reinforced concrete, and the roof is formed of slow-burning timbers with metal lath and plaster underneath and mission tile on the upper side.



FIRST FLOOR

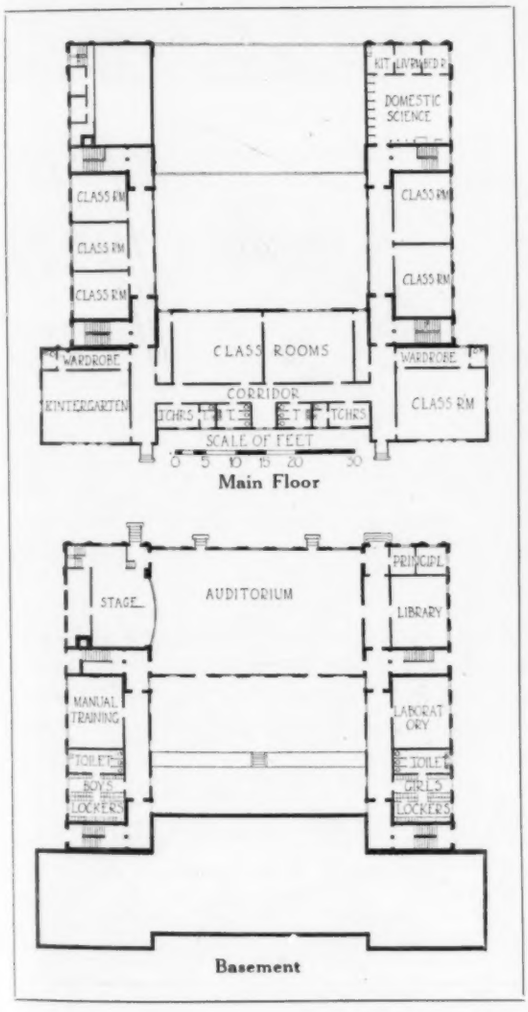


BASEMENT

PLANS, CENTRAL GRADE SCHOOL, GLEN RIDGE, N. J.

GOODWILLIE & MORAN, ARCHITECTS

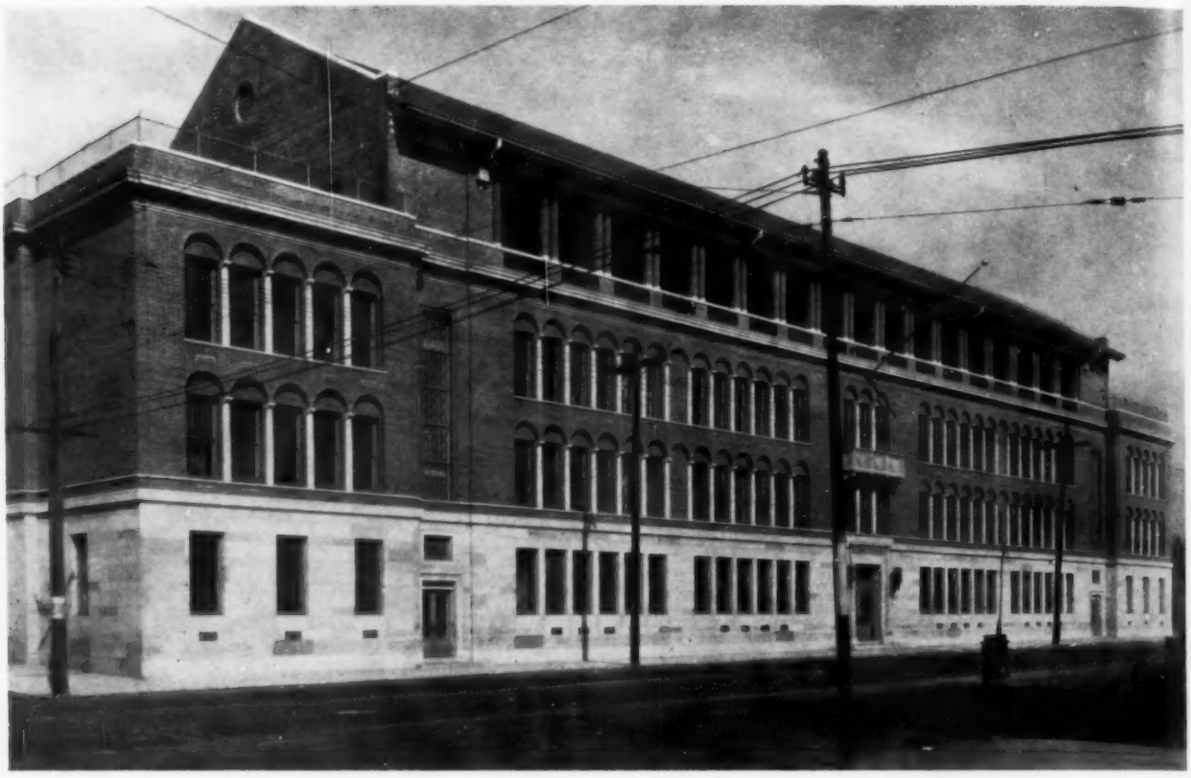
GENERAL VIEW FROM ENTRANCE DRIVE



END BAY ON LOWER LEVEL

In an article on school houses of moderate size which appeared in THE ARCHITECTURAL FORUM for July, 1925 an illustration and plans of the upper part of this hillside school building were shown. This is the portion outlined in black in the basement plan. As the wings and auditorium are built on the lower grade, upper and lower approaches to the building are possible, and the principal entrances are on the ground level.

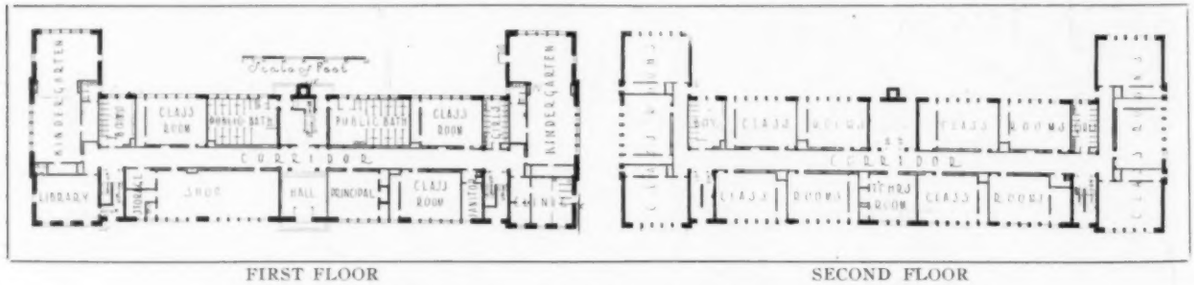
GRADE SCHOOL, SOUTHERN PINES, N. C.
AYMAR EMBURY II, ARCHITECT



FRONT ELEVATION

This building is an excellent example of the adaptation of southern European precedent to the purposes of modern American school architecture. The long rows of classroom windows across the facade of the building are treated with engaged limestone columns, as facing for the mullions, supporting false arches in the brickwork above the windows which gives the effect of galleries or loggias across the entire second and third stories, the windows being recessed somewhat to heighten this effect. The center portion of the building has a fourth story consisting of a large covered play space and two open-air classrooms. The play space is open at the front and rear, and the colonnades forming these openings add still further to the gallery effect. The wings at either end of the building have parapets with iron railings and are paved with wood blocks, forming two additional open-air roof playgrounds. The exterior walls of the first story are of Indiana limestone, the upper portions being finished in brick with considerable limestone trim. The southern European effect of the whole is completed by the sloping roof which is of terra cotta tile.

Ample classroom and recreational space is provided for 1400 pupils, the first three floors being devoted almost entirely to classrooms, while the play space is on the fourth floor as already said. Another unusual feature of the plan is that the two shower rooms on the first floor are public baths. The construction throughout is fireproof, the only wood used being window frames and the finished floors in classrooms and play spaces. The bearing walls are brick and interior columns reinforced concrete. The floors are reinforced concrete of the tin pan type finished with terrazzo in the corridors and toilets. Partitions are of terra cotta and gypsum tile. Work on this building was completed about March 1, 1924, and the total cost was $481,329 or about 37.1 cents per cubic foot. Figured on the basis of a 1400-pupil capacity, this makes a cost of about $344 per pupil.



FIRST FLOOR SECOND FLOOR

CHARLES CARROLL OF CARROLLTON SCHOOL, BALTIMORE

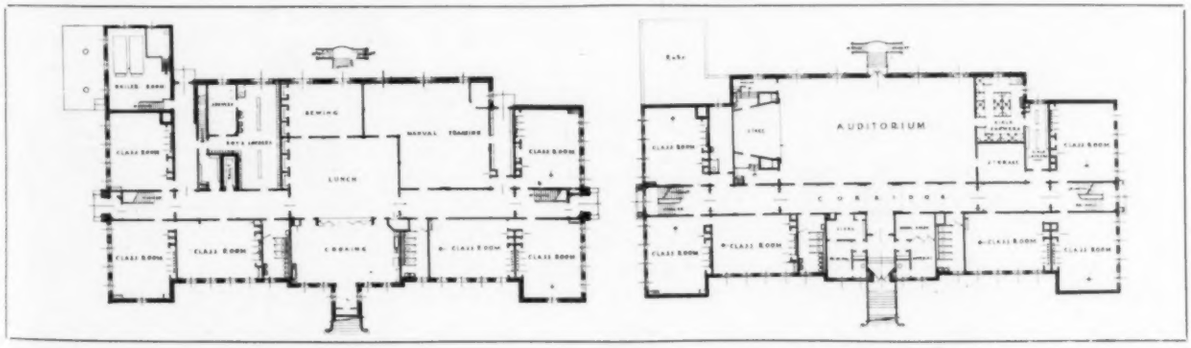
BUCKLER & FENHAGEN, ARCHITECTS

GENERAL VIEW

The Georgian Colonial type of architecture is particularly adaptable to modern school construction where great areas of classroom windows occur in connection with large blank wall spaces, the monotony of which must be relieved in such a way that they form a pleasing part of the whole. The school building illustrated herewith is a very good example of how this can be done, keeping the design in good taste without sacrificing any of the practical considerations of lighting and layout. The exterior treatment is carried out in red brick trimmed with limestone and has wrought iron railings and iron lamp posts at the front entrance steps.

The plans provide accommodation for 600 pupils, and provision is made for extensive future additions in the rear whenever it shall become necessary to expand. There is, in addition to the 17 standard classrooms, lunch rooms, rooms for sewing, cooking, manual training and a library, and a large combined gymnasium and auditorium with a seating capacity of nearly 700. There are also office suites for the superintendent and principal, including waiting rooms, private offices and toilets. The clinic is complete and well equipped, and there are ample locker and shower rooms, and toilet rooms on all floors. Although some of the classrooms are on the basement floor, these are all above natural ground level.

The boiler room, stairways, and corridors are all fireproof construction, and the roofs are of tar and gravel composition. The building was completed in October, 1927 at a cost of $230,000 or 36.6 cents per cubic foot. Had it been built with all floors and roof fireproof, the cubic foot cost would have been about 39.4 cents. Equipment costing $19,000 has been installed in the building. The cost of the school as it was built was about $383 per pupil.



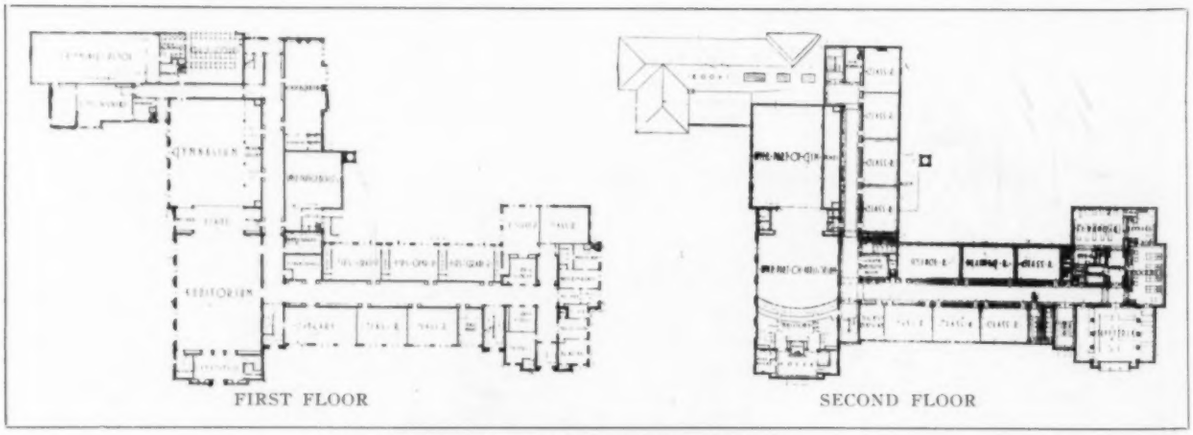
BASEMENT PLAN FIRST FLOOR PLAN

RICHMOND SCHOOL, DANVERS, MASS.

CHARLES G. LORING, ARCHITECT

TOWER AND SIDE ENTRANCE

AUDITORIUM ENTRANCE



FIRST FLOOR SECOND FLOOR

LINCOLN SCHOOL, TRENTON, N. J.

ERNEST SIBLEY & LAWRENCE C. LICHT, ARCHITECTS

SCHOOL GROWTH IN SOUTHERN CALIFORNIA

BY
JOHN C. AUSTIN
ARCHITECT

DURING the past ten years the population of southern California, and more particularly Los Angeles, has increased at such an unprecedented rate that one hesitates to tell of it, fearing that those who read or hear about it will consider it just that much "more southern California 'bunk.'" Yet the federal government, in preparing its annual estimates of the population of cities, usually omits Los Angeles on the ground that it is gaining so fast it is practically impossible to arrive at a fair estimate. Carefully compiled statistics actually show that the average daily attendance in Los Angeles schools of all grades was for 1920 to 1921, 160,278; 1924 to 1925, 274,263; 1926 to 1927, 329,538. These figures have been furnished by the Los Angeles Board of Education and are authentic. Therefore, they represent the actual growth of the school population, and are not a part of the propaganda often employed by real estate dealers to boost their business.

Money derived from bond issues can be used only for the purchase of land and the construction and equipment of buildings. No part of it can be diverted for maintenance and upkeep, the cost of which is met by direct taxation. The growth of the Los Angeles school system, as indicated here, is reflected in every school district in southern California in approximately the same proportion. The percentage of increase in daily average attendance in 1927 over 1926 was 8.6 per cent, the year beginning and ending in September. I have taken the average daily attendance as the measure of growth, rather than the enrollment, owing to the number of pupils who may, and usually do, drop out for various reasons. If the enrollment, purely as such, had been considered during the stated period, the actual increase was 9.75 per cent.

Anyone perusing this article need but compare the percentage of growth in his own district with that recorded here to enable him the better to appreciate the difficult and highly important problem now confronting Los Angeles and all of southern California. The $34,640,000, derived from the last bond issue, of June 3, 1924, was expended in this manner: $22,000,000 for buildings, and the remainder for sites and equipment.

Notwithstanding the trying experiences involved in her usual efforts to raise such large amounts of money at such frequent intervals, southern California has always insisted on employing substantial and fire-resisting construction. For instance, all corridors and stairways, auditoriums and boiler rooms have fireproof floors, walls and ceilings; exterior walls are of either brick or concrete. Classroom floors and partitions are generally of wood. This was the method of construction quite universally followed until recent ordinances enacted by the authorities made it compulsory for all buildings of more than two stories to be of fireproof construction throughout. This action, of course, met with the hearty endorsement of a majority of the architects, who believe it is but a forerunner of what will inevitably follow before long, namely, "that all schools, regardless of size or height, must be absolutely fireproof" to properly safeguard the lives of the children and their instructors. While only the city of Los Angeles is affected by such legislation, it is certain, in time, to exert a wholesome influence on adjacent communities, always ready and eager to copy the older and larger city. Most elementary schools are two-storied, some senior and junior highs three-storied. Therefore, larger sites must naturally be provided than in districts where buildings of greater height are permitted.

The work of qualified school architects has, in many cases at any rate, been recognized, and their services are coming to be more and more appreciated by the school-governing bodies, as they realize that a building with carefully studied, convenient and practical plan and a well designed exterior is by far the most economical kind to construct. They also recognize the fact that good and attractive schools draw new settlers to the districts in which they are located, and that in due course these people become permanent and substantial citizens.

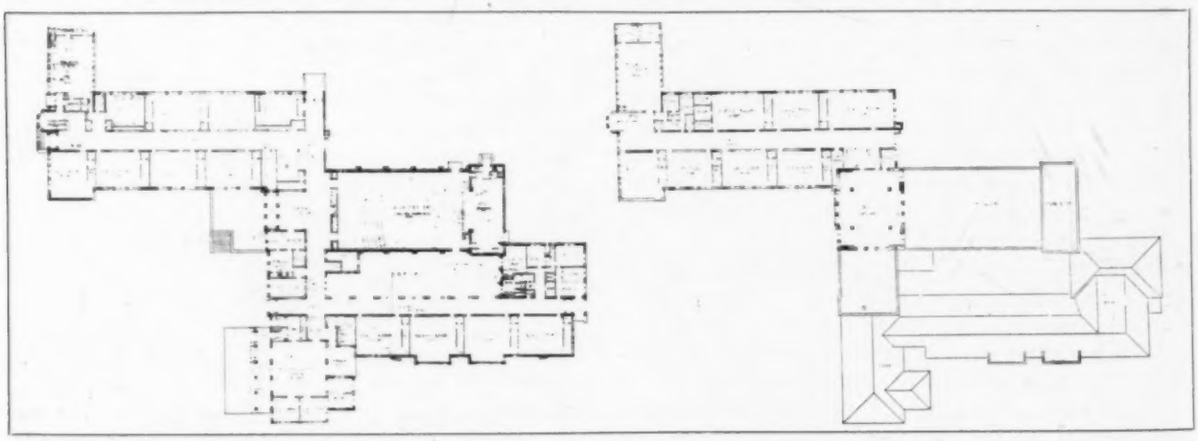
There are included here some illustrations of an elementary school just completed at Beverly Hills, a very popular and rapidly growing community between Los Angeles and the ocean, and considered to be essentially a part of Los Angeles. This building, erected at a cost of $400,000 exclusive of site and equipment, is situated on a gently sloping knoll with an area of about 6.5 acres. It is contiguous to the grounds of a country club on two sides and borders on fine boulevards on the other two. The general plan is not only unusual, but quite unique, in my opinion, inasmuch as the arrangement separates the younger children from the older and provides each with independent toilet facilities and playgrounds. Special attention is directed to the peculiar requirements of the kindergarten, and first and second grades, in which the rooms were planned primarily to accommodate the equipment and were not considered to be part of a series of classrooms of stereotyped or standard form and size and wholly lacking in individuality. The auditorium seats 750 and has a fully equipped stage, 25 x 52 feet in size, that can be used for concerts, lectures, theatricals, etc., and also for community gatherings as well as for the usual school purposes. The manual training (Sloyd) department consists of a main workshop, rooms for glueing and finishing, lumber storage, tools and sheet metal work, and an instructors' office having full

El Rodeo de las Aguas School, Beverly Hills, Cal.

command of the entire department. The domestic science department consists of a workroom, which is sub-divided into a number of small kitchens, special instruction room, locker room, and dining room, pantry and miniature kitchen. Sewing, fitting, work and supply rooms are essential parts of this department.

The grade classrooms from the third to the seventh are alike, but attention is directed to the convenience of coat rooms and supply closets in each and every one. Free textbooks are supplied by the state of California to the pupils of all public schools. Therefore, a special room for them is provided as near the center of the building as possible. The books are distributed to each classroom, and the teacher is held responsible for them. The administration department occupies the center of the building, and has full command of the main entrance and auditorium, also a good view of the boys' playground. The physical director's rooms are located on a mezzanine floor above the administration department, and are easily accessible to or from the first and second stories. The cafeteria will accommodate 300 and is situated in the basement which, owing to the contour of the ground, is not actually a basement, the floor being level with the finished grade on the east, and splendid light obtained by means of a generous area on the west. I have described this school in detail because it seems to be fairly typical of many erected in this district in recent years. Naturally, while every school cannot have such ideal surroundings, each department in such a school should be arranged to provide every practical convenience contained in this school, known as *"El Rodeo de las Aguas,"* Spanish, meaning "the gathering of the waters."

The heating and ventilating of California schools are not as much of a problem as they are in districts where extremes of temperature commonly prevail. Usually the auditorium and the chemistry department are equipped with plenum systems, all other parts being heated by direct steam and ventilated by leaving the windows open from one year's end to another. Every conceivable style of architecture can be found in our school buildings, but those types indigenous to the countries bordering the Mediterranean appear to be in better harmony with the historical background, foliage and climate of southern



First Floor Second Floor

Plans, El Rodeo de las Aguas School, Beverly Hills, Cal.

John C. Austin, Frederick M. Ashley, and W. Asa Hudson, Architects

El Rodeo de las Aguas School from the Northwest

California, though the Tudor and English Collegiate styles of architecture fit in with many of our picturesque sites and, intelligently handled, readily become a part of the landscape, just as though they had been dropped on the spot. Our costs of construction are very low compared with those of other districts, and for many obvious reasons. All of our building materials, excepting structural steel, are either manufactured or obtained within 50 miles of the building sites, thus enabling our boards of education to stretch their appropriations so as to produce the "most building for the least money" and thereby receive the approbation of the usually critical and sensitive public. It is no more than 15 or 20 years at most since the use of brick was generally adopted in the construction of our schools in lieu of wood, which is still employed, however, for classroom floors, partitions and roof framing in buildings of under three stories. In a few isolated cases reinforced concrete has been used for interior as well as for exterior walls and, at the present writing, it is common practice to make corridor floors and ceilings, stairways, boiler rooms and (occasionally only) auditoriums of concrete.

As already said, all schools of more than two stories, hereafter erected in Los Angeles, must be

Main Entrance, El Rodeo de las Aguas School, Beverly Hills, Cal.
John C. Austin, Frederick M. Ashley, and W. Asa Hudson, Architects

fireproof throughout, in the sense that such construction is generally understood. Vast improvement has been made in the general planning of grade schools, and in the designing of their exteriors, to which, it is quite evident, much serious study and thoughtful consideration are being devoted. The combination of brick or terra cotta, with natural or artificial stone, the latter predominating, owing principally to its lower cost and the fact that there is no suitable stone in this vicinity except granite, has produced many creditable and attractive schools. These have served to stimulate public interest to such an extent that the people not only expect the standard to be maintained but even raised, whenever conditions should justify the indulgence in schools of higher æsthetic character and value. In fact the public is actually beginning to show signs of education, and seems to be better able to discriminate.

Because of the great size of the Los Angeles school district, much of which is sparsely settled, more schools are required in proportion to population than in a community more densely settled. In some sections the only way to solve the transportation problem has been to build more schools. Schools have had to be provided for large communities where, a few years before, there was only vacant land. The attendance at one school which opened with 100 children increased to 1668 in less than two years, rendering quick action in providing additional buildings imperative. Other similar instances could be cited, but this seems to be sufficient to convey a faint idea, at least, of the rapidity of school growth.

Again, in a district inhabited by people of the better class, it is possible, through larger returns yielded by the tax, to secure a school fully equipped to meet all requirements of that particular locality, while in less favored districts this is manifestly impossible. I have in mind a case in point. Some years ago I built a high school in Antelope Valley, about 75 or 80 miles from Los Angeles. This section, about equal in area to the state of Rhode Island, was sparsely settled by people, most of whom were practically compelled to live there because of the state of their health and finances. Many were situated at points so remote from the school that we found it necessary to provide dormitories to house those pupils who were unable to go back and forth in time for the sessions. So they would go home on Friday, returning on Sunday, and meanwhile find lodging in the dormitories. On the occasion of my visits there, after the school was completed and in operation, I was amazed to observe the hardy type of children in attendance, and the eagerness with which they tackled their studies. It was certainly a refreshing and unusual sight, considering the fact that most of them came from very poor homes.

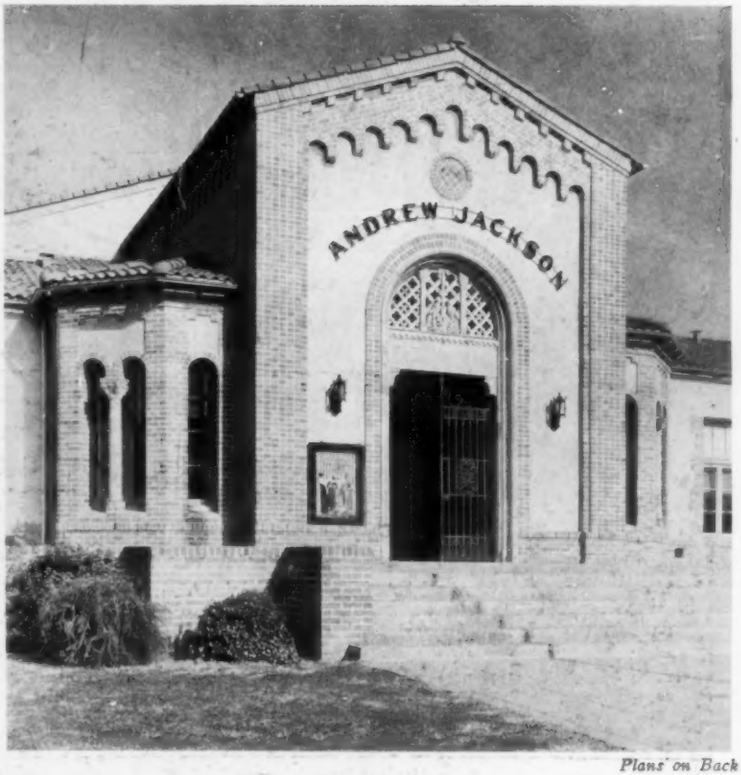
In conclusion, I am so bold as to venture the statement that, all things considered, our schools compare favorably with the best in other parts of the country and, in many respects, even excel them.

High School, Los Angeles
John C. Austin, Architect

GENERAL VIEW

Lying as it does in the midst of a broad fertile plain with the mountains for a background, there is a suggestion of northern Italy in the Romanesque treatment of this California school. The general proportions are low-lying and rambling, the main building being laid out in the form of a great L with a cloistered quadrangle in the angle having a large auditorium as its other enclosing wall. The building has been built in two sections at different times and is evidently planned for still further addition in the form of a wing on the right to balance the present wing on the left. Although the greater portion is only one story in height, the rear part of the wing on the left has been carried up a second story to make room for six additional classrooms. Besides having 18 classrooms, the plan provides ample toilet facilities as well as offices, library, auditorium and other rooms for general activities.

The exterior finish is of light colored stucco in combination with light colored variegated brick, used as trim, in which the Romanesque detail is worked out. This in combination with tile roofs gives a southern European effect which is particularly fitting.



Plans on Back

MAIN ENTRANCE

ANDREW JACKSON SCHOOL, PASADENA

MARSTON, VAN PELT & MAYBURY, ARCHITECTS

COST AND CONSTRUCTION DATA

As originally constructed in 1921, the cost of this school was $97,550. An addition was made in 1926 costing $59,670, which makes the total cost $157,220 or approximately 25 cents per cubic foot. It is planned to accommodate 570 pupils, making the cost per pupil about $276. The value of the equipment used in the building is $6,500.

The exterior walls are of brick and stucco; floor joists and partition studs are of wood with metal lath and plaster. The roof covering is tile.

FIRST AND SECOND FLOORS

PLANS, ANDREW JACKSON SCHOOL, PASADENA

MARSTON, VAN PELT & MAYBURY, ARHITECTS

GENERAL VIEW

DETAIL, ENTRANCE PORCH

Plan on Back

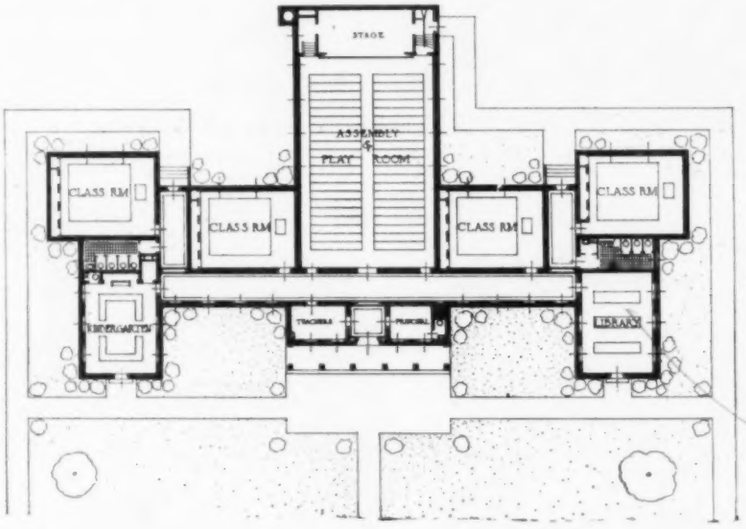
ELEMENTARY SCHOOL, MASSAPEQUA, N. Y.

ERNEST SIBLEY AND LAWRENCE C. LICHT, ARCHITECTS

COST AND CONSTRUCTION DATA

One hundred and seventy-five pupils may be accommodated in this one-story school building, which was erected in 1926 at a cost of $76,000 or 37 cents per cubic foot.

The exterior walls are of face brick, and the roof covering is slate.



FIRST FLOOR

PLAN, ELEMENTARY SCHOOL, MASSAPEQUA, N. Y.

ERNEST SIBLEY AND LAWRENCE C. LICHT, ARCHITECTS

GENERAL VIEW

ENTRANCE PORTICO

Plan on Back

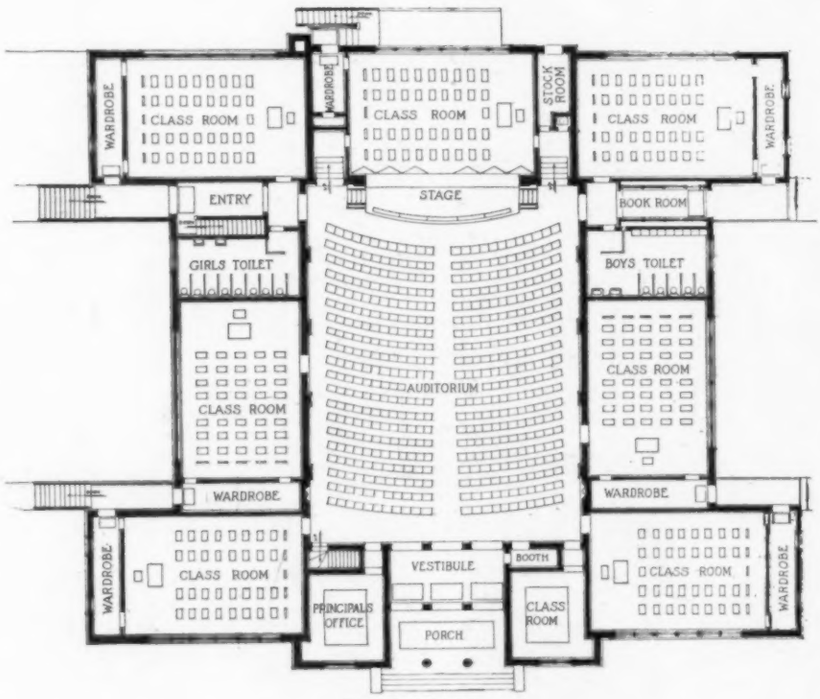
COMMODORE MACDONOUGH SCHOOL, ST. GEORGES, DEL.

GUILBERT & BETELLE, ARCHITECTS

COST AND CONSTRUCTION DATA

Completed in February, 1924 at a total cost of $105,198 or 34 cents per cubic foot, this school is designed for 300 pupils, making the cost per pupil $350.66.

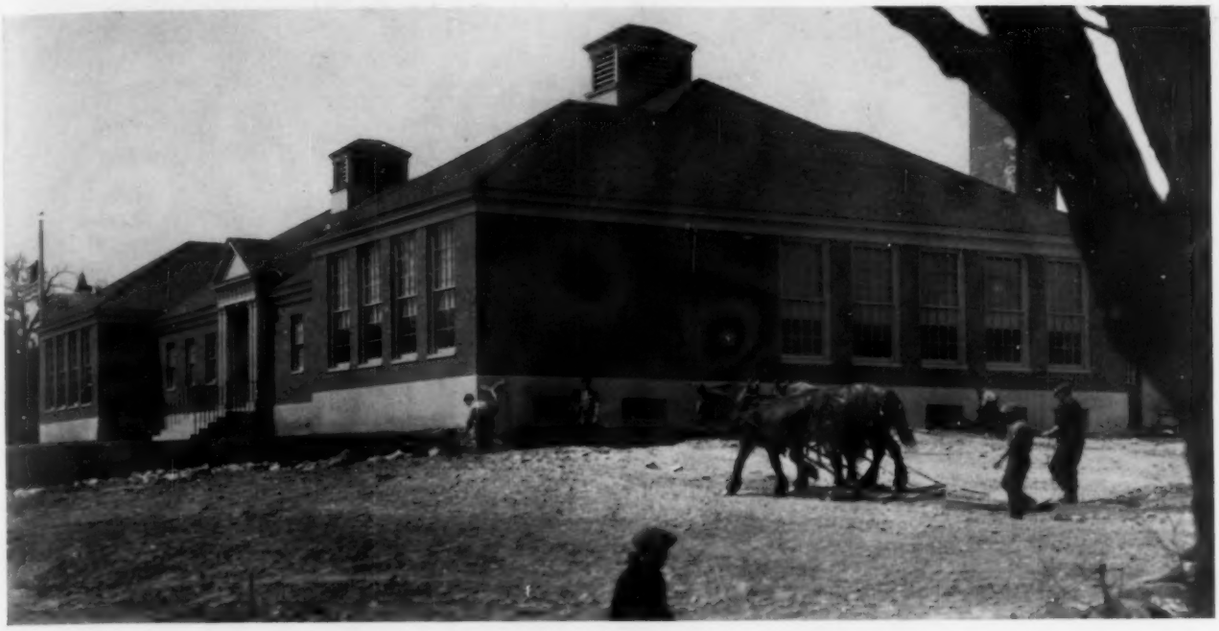
Although not completely fireproof, the building is of slow-burning construction with brick exterior and composition roof.



FIRST FLOOR

PLAN, COMMODORE MACDONOUGH SCHOOL, ST. GEORGES, DEL.

GUILBERT & BETELLE, ARCHITECTS



GENERAL VIEW

Built in the American Colonial style, the beauty of this school building lies in its simplicity, the general proportions, and the classical design of the Doric entrance portico. The treatment of the various roof areas is rather interesting, and the two ventilators surmounting the whole are in harmony with the general proportions of the building. The plan and utility of the layout are frankly expressed by the exterior treatment, there being no attempt to ornament in any way the large unbroken wall spaces occurring on the unlighted sides of the classrooms. The exterior finish is plain brick unornamented in any way except for the entrance, which is of white painted wood, with a graceful wrought iron railing for the steps.

The plan of the building is also very simple, consisting only of six classrooms, two toilets, a teachers' room and the necessary corridors and hall. The heating apparatus is located in the basement. The arrangement of wardrobes in the classrooms seems to be particularly successful.

Photos. Paul J. Weber *Plan on Back*

MAIN ENTRANCE

PACKARD STREET SCHOOL, HUDSON, MASS.

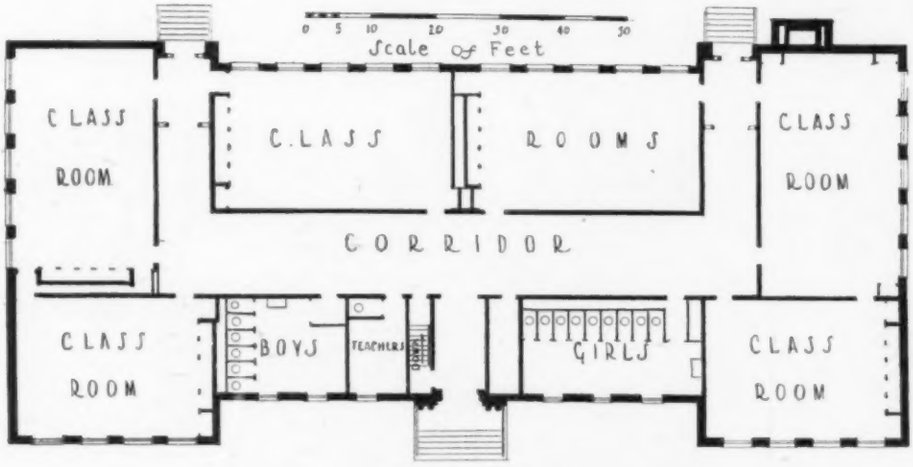
JOSEPH D. LELAND & COMPANY, ARCHITECTS

UNIV. OF MICH.

COST AND CONSTRUCTION DATA

Of the bungalow or one-story type, this school was completed in June, 1925, with a capacity of 210 pupils at a cost of $72,983 or 30.17 cents per cubic foot.

Exterior walls are of brick and hollow tile, and the floors, partitions, and roof are of wood construction.



FIRST FLOOR

PLAN, PACKARD STREET SCHOOL, HUDSON, MASS.
JOSEPH D. LELAND & COMPANY, ARCHITECTS

GENERAL VIEW

The principal interest in this bungalow type school, aside from the beauty of the general proportions, is centered in the classical entrance detail, and the graceful cupola which surmounts the roof at the center of the building. The entrance is particularly pleasing, being worked out as a modification of the Doric order in wood painted white, forming a pleasing contrast to the rest of the building which is of plain brick and practically unornamented. The basement course is also of contrasting color, being of white concrete, as are the front entrance steps, which are finished with an iron railing of pleasing design.

In plan the building is also exceedingly simple, being laid out in the form of an "H" and containing merely six classrooms, two toilet rooms and a room for the use of teachers. The boiler room and other mechanical equipment is located in the basement, leaving the entire space on the main floor free for school purposes. In plan and design this building is an admirable example of effective simplicity.

Photos. Paul J. Weber

MAIN ENTRANCE

Plan on Back

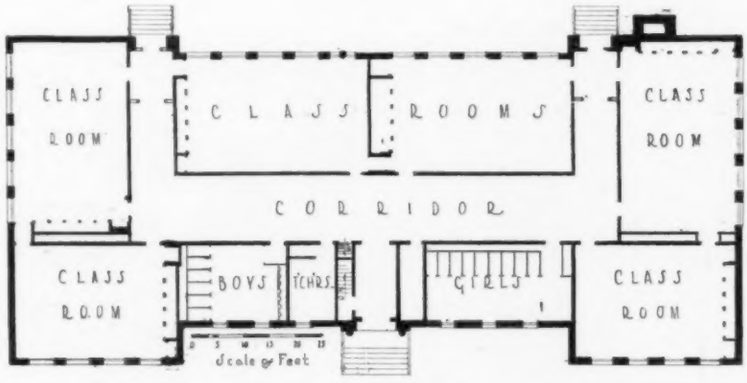
BROAD STREET SCHOOL, HUDSON, MASS.

JOSEPH D. LELAND & COMPANY, ARCHITECTS

COST AND CONSTRUCTION DATA

The total cost of this building, completed in June, 1925, was $74,346 and the cubic foot cost was 30.69 cents. Each of the six classrooms has a capacity of about 35 pupils, making a total of 210.

The exterior walls are of brick backed up with structural tile. The floors, partitions and roof are of wood construction.



FIRST FLOOR

PLAN, BROAD STREET SCHOOL, HUDSON, MASS.

JOSEPH D. LELAND & COMPANY, ARCHITECTS

VIEW FROM THE COURT

Photos. Gabriel Moulin

Plan on Back

GENERAL VIEW FROM THE HIGHROAD

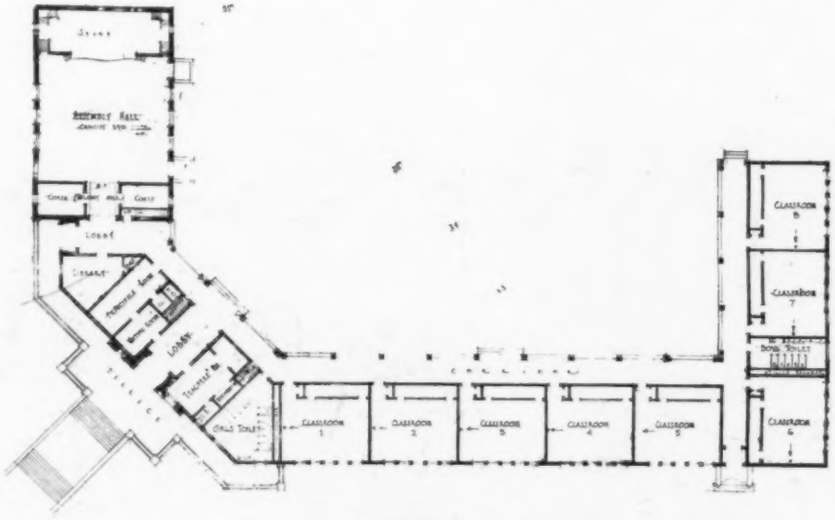
CENTRAL GRAMMAR SCHOOL, SAN MATEO, CAL.

JOHN J. DONOVAN & SYLVAIN SCHNAITTACHER, ARCHITECTS

COST AND CONSTRUCTION DATA

Costing approximately $88,000, this school was built in 1923 with a capacity of 360 pupils. Cost per cubic foot was 25 cents.

The general construction is concrete with an exterior finish of stucco and tile roofs. The floors are of maple, and the interior trim is Douglas fir.



GENERAL PLAN

PLAN, CENTRAL GRAMMAR SCHOOL, SAN MATEO, CAL.

JOHN J. DONOVAN & SYLVAIN SCHNAITTACHER, ARCHITECTS

GENERAL VIEW

ENTRANCE PORTICO

Plan on Back

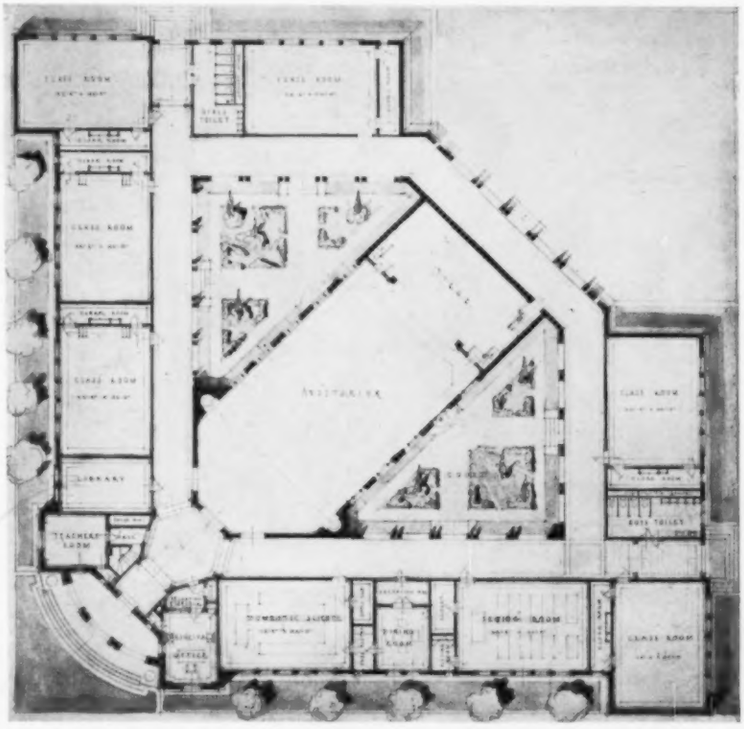
GRAMMAR SCHOOL, HOLLISTER, CAL.

W. H. WEEKS, ARCHITECT

COST AND CONSTRUCTION DATA

Constructed of pressed brick and artificial stone, with terra cotta tile roof, this one-story school building was completed in 1922 with a capacity of 225 pupils.

The total cost was about $100,000 or about 26 cents per cubic foot, making the cost per pupil $444.



GENERAL PLAN

GRAMMAR SCHOOL, HOLLISTER, CAL.

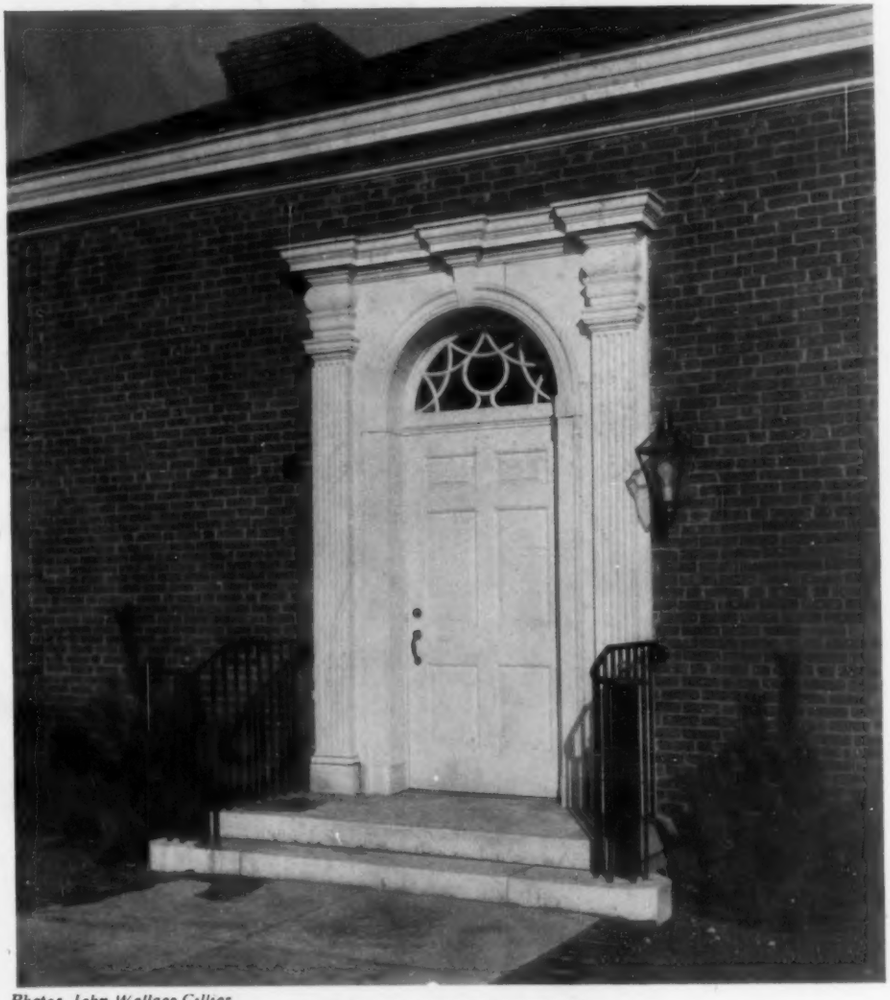
W. H. WEEKS, ARCHITECT

GENERAL VIEW

The simplicity of the Colonial design used here is very pleasing in a school of this type. Being all on one floor and designed for a capacity of 385 students, it necessarily covers considerable area and is laid out with two wings containing classrooms on either side of the central section in which are located the library, assembly room, teachers' and principal's rooms and some classrooms.

The exterior treatment is carried out in plain brick laid at the corners to give the effect of quoins. The main or central entrance consists of a rather plain brick arch with white stone keystone and impost blocks. The side entrances in either wing are somewhat more decorative, being of white woodwork in pleasing Colonial design. All the entrance steps have graceful iron railings.

The building was completed in 1926 and cost $152,000 or 37.5 cents per cubic foot. This makes the cost per pupil about $457, without counting the cost of the building's equipment.



Photos. John Wallace Gillies

ENTRANCE TO MUSIC ROOM

FRANKLIN SCHOOL, HEMPSTEAD, N. Y.
ERNEST SIBLEY & LAWRENCE C. LICHT, ARCHITECTS

U. OF MICH.

THE ONE-STORY SCHOOLHOUSE

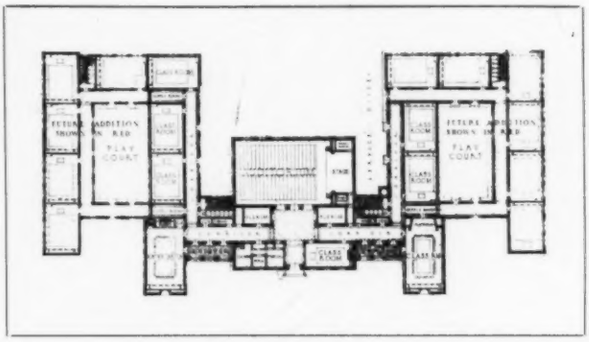
BY

MATLACK PRICE

THERE is a growing feeling that the ideal elementary or primary school building for the suburban community is the one-story type, which is not only attractive in itself but attractive likewise in its relation to the residential character of its environment. For this reason, also, it can definitely be said that it adds to the character of a residential neighborhood rather than in any way detracting from it, and its low lines give something of a domestic quality that correlates the school with the home.

Recent school buildings in progressive communities have been designed in general character with the styles suggested by locality or precedent, and architects make every effort to create stylistic harmony throughout the entire school system of the community. The one-story primary school, thus, is designed as a building related to the larger school buildings, and a pleasing consistency is the result. This harmony in design has been carried out with excellent effect at Hempstead, New York, where the high school is a monumental building of Georgian Colonial design, and the Franklin and Fulton primary schools are of the one-story type, adapting the same stylistic manner. Generous shelters have been provided for these two buildings, giving ample protection to the pupils who arrive early and furnishing a play space for use in bad weather. Certain conditions which are part of the daily routine of the primary school have led architects to give their best attention to meeting these conditions with definitely intentioned plan features. Since play and physical training are essential parts of modern school procedure, even for very small children, the large corridor or lobby in front of the assembly room is an important element in the plan. And in the assembly room itself, which has an average seating capacity of 450, half the floor space is left open for play and for physical exercises. The portion provided with seats is designed to accommodate class groups in assembly.

School boards have found that definite advantages are secured through professional architectural guidance in this, as in any other school project, and that the architect can and will be glad to assist with the landscaping problem, and with such details as furniture, draperies and equipment, all of which should harmonize in character and color with the entire scheme. The details may seem unimportant, and yet if they are neglected or poorly done much of the result of the architect's skill and labor may be lost, or at least rendered far less effective than might otherwise be the case. The necessity for practicing economy is ever present with boards of education, and on this account they often hesitate to employ the architect's services on these supposedly unimportant details of the work. Any architect, however, who desires the complete and ultimate success of his building, is entitled to render such service, and would rather do so than discover, at the end, that the setting for the building or its furniture and its other equipment do not faithfully carry out his orig-



Main Floor Plan

Elementary School No. 4, Bergenfield, N. J.

Ernest Sibley and Lawrence C. Licht, Architects

Library, Elementary School No. 4, Bergenfield, N. J.

inal conception of the finished scheme. Among other features provided by the architect who equips as well as designs the school building are ventilated wardrobes at the rears of the classrooms, the doors of which open and close together. Above the blackboards are exhibition boards, covered with soft-toned burlap and planned to provide generous exhibition space. The music room is provided with a stage, with an entrance from the corridor, and this room proves a valuable adjunct to the school for classes in visual instructions, civics, theatricals and for Mothers' and Parent-Teachers' meetings.

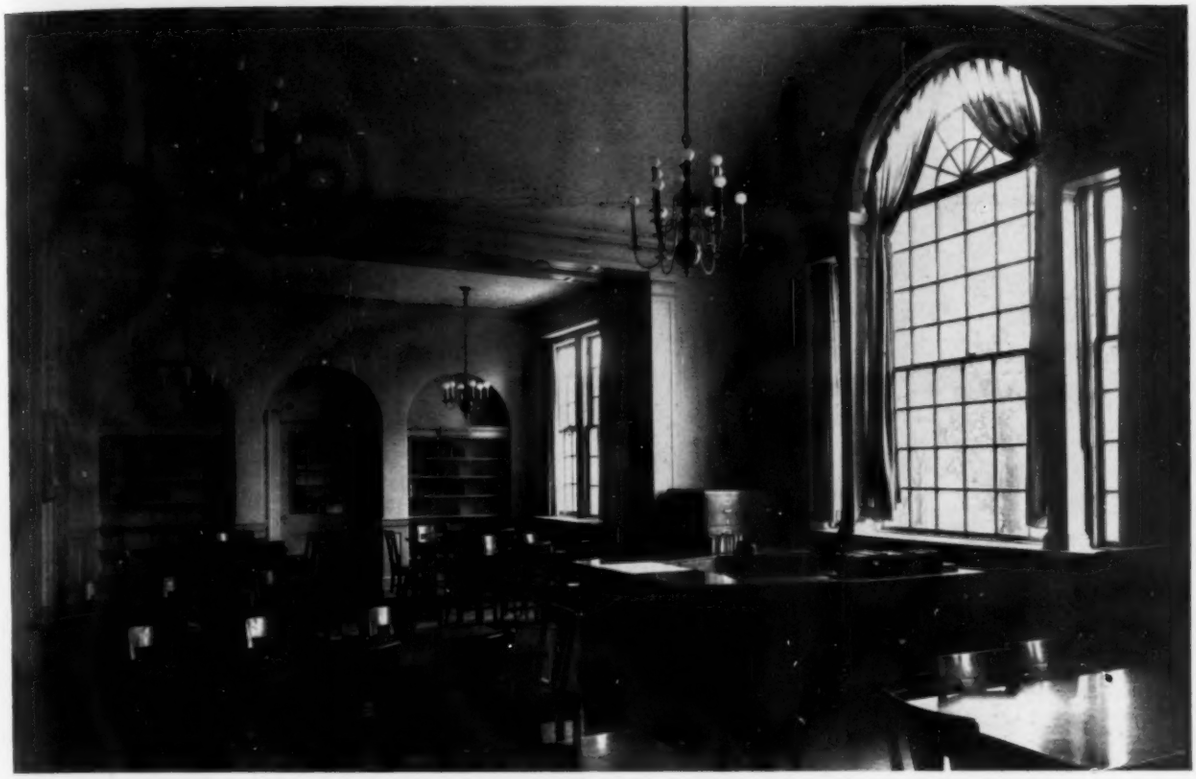
A little specific information is more valuable than quantities of generalities, and architects and school boards alike will probably find considerable definite suggestion in the notes on a few primary school buildings illustrated in connection with this number.

Plate 80 illustrates the Franklin School. If it were possible to cite the source which inspired the design of this building, as well as some others also presented here, the old Colonial mansions and homesteads of Maryland and Virginia would come nearest to supplying the answer. Three characteristic features have been retained,—the main center building, its two end wings, and their connection by means of open shelters, as at Mt. Vernon. Only sufficient basement space was allowed to accommodate the oil burners, so that the building is but three steps above the ground. A large kindergarten provides work and play space for kindergarten and first grade children, and the music and visual instruction room, and the library, with book shelves and fireplace, are delight-

Music Room, Elementary School No. 4

Kindergarten, Elementary School No. 4

Ernest Sibley and Lawrence C. Licht, Architects



Library, Junior High School No. 3, Trenton, N. J.

ful innovations in this modern primary school. Little chairs and tables of Colonial design, a miniature piano, attractive hangings and accessories everywhere greet the eye, and so completely is the spirit of childhood expressed throughout that one experiences a feeling of surprise when an adult enters the picture. The building is planned for future extension, with possibly a two-story wing in the rear, if the growth of the community demands it, thus forming across the court a background for the beautiful, homelike facade of the little children's schoolhouse. The school just described cost, in the metropolitan district, about $130,000, which is probably 20 per cent or 30 per cent more than it would cost in the middle west and south. It is of fireproof construction, excepting the roof timbers, and has face brick on all sides. Due to the saving in heavy construction, floor slabs and the other structural necessities of larger buildings, the cost per pupil for similar construction is appreciably lower than in buildings of two or three stories.

Elementary School No. 4 at Bergenfield, New Jersey, is a building of a type similar to that just described. It was recently completed, and is planned, due to its site, for a different scheme of enlargement. Its unusual charm is evident in the accompanying reproduction of a water color drawing, but for a more adequate impression photographs (not yet available) of the finished building are essential. This school has been built at a cost of about $152,000.

The Massapequa School. The variety of plan and design possible in schools of this same size and type,

Kindergarten Wardrobes, Elementary School No. 4

End of Library, Orange High School, Orange, N. J.

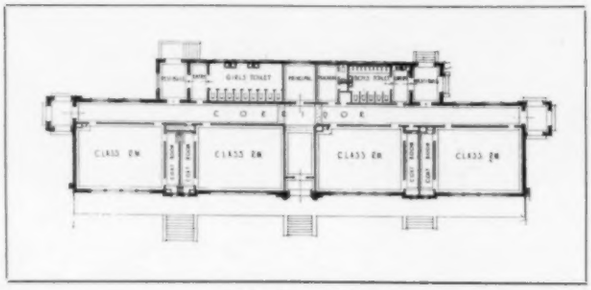
Ernest Sibley and Lawrence C. Licht, Architects

Grant Open Air Elementary School, San Diego

and serving the same general purpose of housing the primary grades, is indicated by the unusually quaint building, with its unique plan, developed for Massapequa, New York. (Plate 74.)

School for School District No. 1 and Owen D. Young. Van Hornesville, New York. When the village school at Van Hornesville, New York burned to the ground last year, Owen D. Young saw his opportunity to give to the school children of his home town a building that would give them more complete educational opportunities than are usually provided in a rural community. His love and appreciation of all that is native to Van Hornesville and its vicinity caused Mr. Young to decide not to import anything necessary to the building of the new school,—excepting his architects. Securing the choice of all the available building sites, he proceeded to engage local workmen exclusively, and one of the most interesting facts about the entire project has been that the youngest skilled workman on the work was 67 years of age and the oldest 83. They are master craftsmen of the old kind,—a type rapidly vanishing. Old walls dividing the Young, Van Horne and other nearby farms furnished the stone for the walls of the building, and these, when split ready to be laid, revealed a wonderful variety of sparkling color effects in red, black, lavender, rust and gray.

In addition to two regular classrooms which can be thrown together for community purposes, the building provides rooms for manual training, domestic science, teachers' room, and a library, which will also be the library for the village. Nor does the ultimate plan stop here, for it has been laid out with



Main Floor Plan

Grant Open Air Elementary School, San Diego
T. C. Kistner & Co., Architects

a view to indefinite enlargement, by a group scheme, and eventually it may comprise a district high school. The rooms at the rear of the building overlook a large playground, seen across the picturesque Otsquaga Creek, which is crossed by rustic bridges, which are a part of the landscaping scheme. It is an appropriately simple scheme, planned by Mortimer Merritt, landscape architect, and will provide a setting for the building which will form altogether a delightful picture. As the ground at the rear slopes rapidly away toward the bank of the creek, this natural grade allows for an entrance under the classrooms, and for a spacious room for the storage of playground apparatus during the long winter. Beautiful floors and woodwork are being put in place, and the building is equipped with the best and most modern of plumbing, heating and electrical systems, special provision being made so that all developments in radio, vitaphone and television may be enjoyed within the building. The furniture, which is to reproduce early American forms, is being made by a few veteran craftsmen.

The present building overlooks the main highway between Cooperstown and Fort Plain, and has already attracted wide attention, not only on account of its beauty and the surprise of finding it in so small and unpretentious a community, but because the donor, Mr. Young, is a figure of national and international prominence. Born in the hills overlooking the village which his ancestors settled generations ago, Mr. Young now maintains his most frequented residence, "By the Side of the Road," in the village of Van Hornesville, which he has beautified.

THE PRIVATE SCHOOL

BY

CHARLES G. LORING, ARCHITECT

THE characteristic flavor of a private school may be derived from advanced educational theories or from the acute social desires of its organizers and clientele. These surprisingly diverse motives, even when they occur simultaneously, can be easily reconciled by the architect. An out-and-out educator looks upon the institution as an opportunity for research, for the introduction of new and better methods of developing the minds and characters of the young. The worldly-wise parent looks upon the private school as the matter-of-course means for the selection of the fittest human environment. Unlike as they are, the earnest believers in these two creeds have one common denominator,—the avoidance of mass production.

In designing public school houses, the architect is cribbed, cabined and confined. The building committee has only limited funds; the new structure must not cost more than so many cents per cubic foot, nor more than so many dollars per pupil. For economy in teaching force, the classrooms must hold the determined maximum which one teacher can put through the daily mill. Regulations prescribe the minimum breadth of corridors, the minimum number of toilet fixtures, the minimum area of windows, the minimum width of treads, and seldom are these basic limits exceeded. The inspiring challenge to the imaginative designer, after the skill and common sense of the planner and the builder in him have done their utmost, is to clothe the factory of education with a dignity and graciousness which will in some measure stimulate the pupils and their teachers and enhance the beauty of the community.

Private school buildings are the products of successful business ventures or the remorseless extraction of "loans" from parents, or of fine, fat endowment funds. Occasionally, when the wherewithal is not adequate for a permanent plant, an old house is remodeled or a frankly temporary and experimental structure is evolved. The latter is often somewhat akin to the small, one-teacher schools in the country or the "portable bungalows," the overflow makeshifts in congested cities. The Shady Hill group, designed by S. W. Mead, was built on a strictly limited budget and on the assumption that wooden roofs and walls of clapboards lined with plasterboard would last till new generations of parents had rolled up a fund for a more permanent type of construction. There are nine buildings in the little village, all one story in height. Four house the assembly hall with administrative offices and show rooms, the laboratory, the studio and the carpentry shop; the other five units each contain two classrooms, each with a supplementary small workroom connected by glazed double doors, and two toilet rooms. The classrooms have one long side to the south and one end with continuous windows so glazed that they may be completely opened, and additional windows on the north. The rooms have sufficient depth to allow the movable desks and chairs to be pushed back out of the direct sun. Simplicity, freedom, quiet and fresh air were the key words in the coöperative venture, jointly developed by parents, teachers and architect.

In private schools the classrooms have fewer

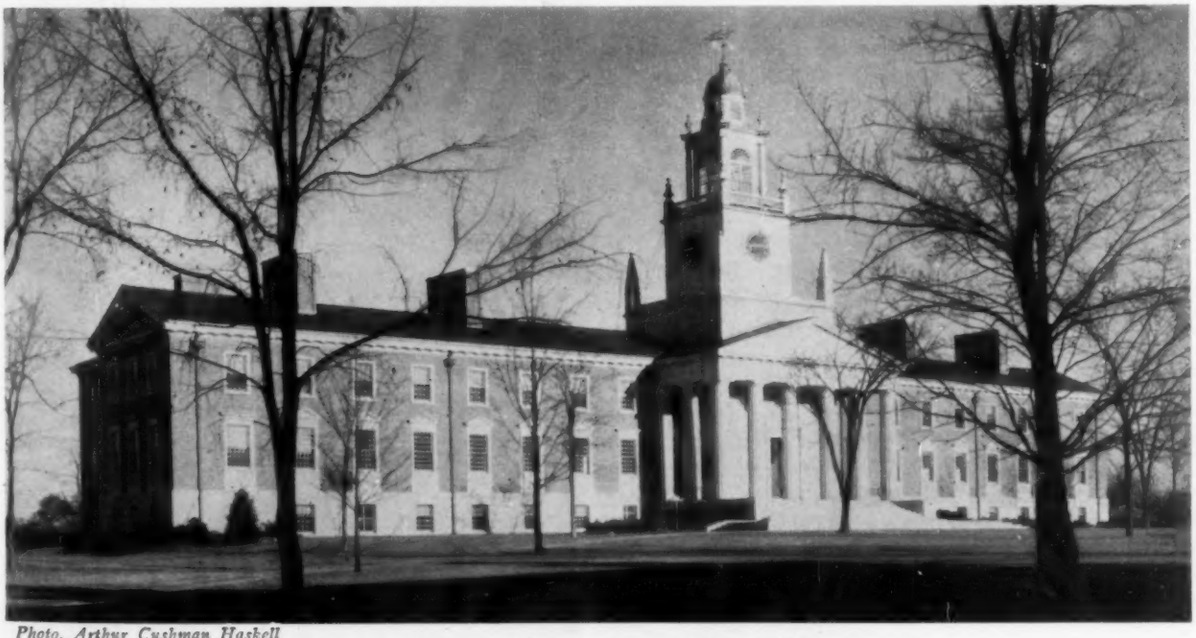


Photo. Arthur Cushman Haskell

Building at Phillips Academy, Andover, Mass.

Guy Lowell, Architect

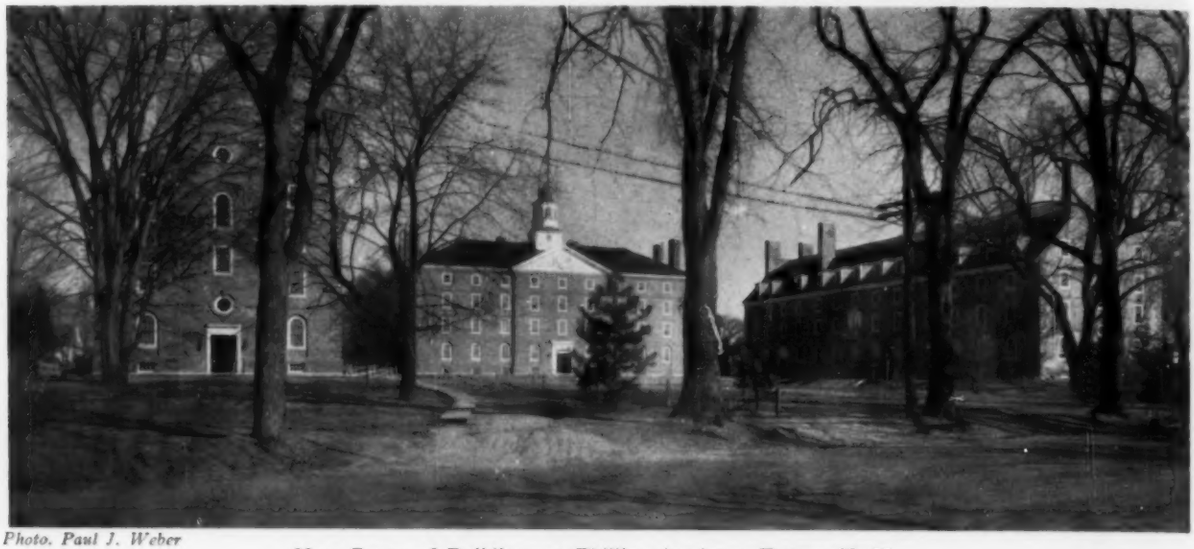


Photo. Paul J. Weber

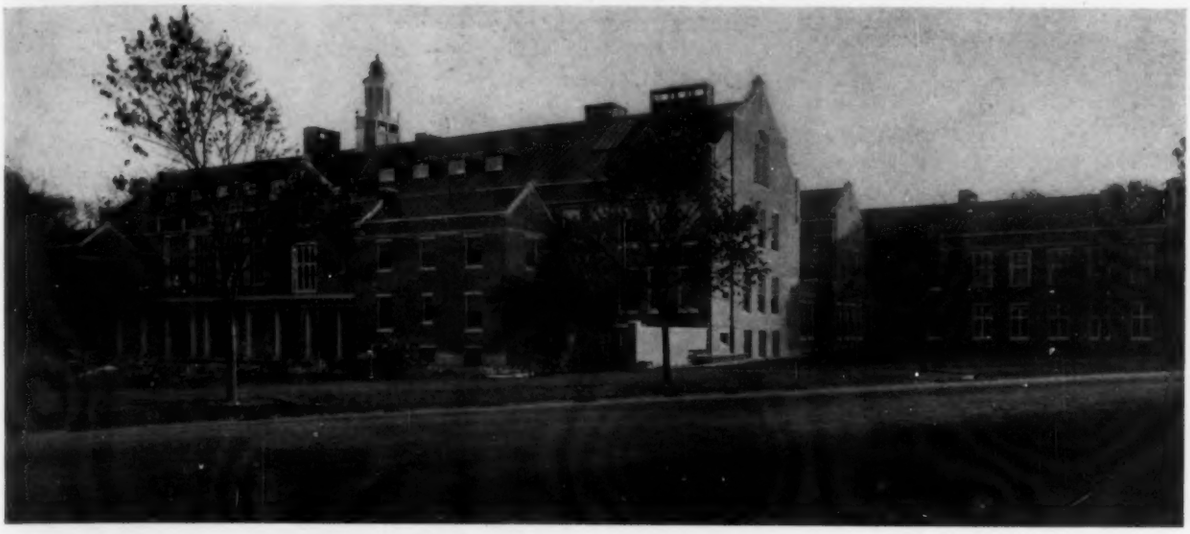
New Group of Buildings at Phillips Academy, Exeter, N. H.
Cram & Ferguson, Architects

pupils than in the public schools,— often no more than 20 for the upper grades and 15 for the lower, in place of the usual 35 or 42, but the rooms themselves may be no smaller. In fact for the younger pupils there is often a clear space left near the desk for group work, and for the older pupils for conferences and seminars. In municipal schools a fireplace is not considered a luxury in the kindergartens, and this attractive (and hygienic) feature is carried into the upper grade rooms in many private academies to relieve the austerities of blackboards and desks. Open-air classrooms, or at least classrooms which can be opened up on two or three sides, are sometimes introduced, though this feature is not in such vogue as formerly, the eccentricities of American winter climate tending to restrict their use. The introduction on a commercial basis of window glass which allows the passage of the sun's ultra-violet rays has appropriated for the average schoolroom one of the advantages of the open-air type. The rest room for day pupils is a definite feature, and it may sometimes be in the form of a loggia and sometimes as an adjunct to the lunch room.

In some states and localities the boards and inspectors who try to teach the teachers how to plan to the best advantage for the health of the pupils prescribe rules for ventilation, circulation and fenestration. Massachusetts, for instance, calls for windows with one-fifth the classroom floor area, two means of egress from each room, and fan ventilation. New Hampshire in her public schools allows window vetilation, but is dead set against windows placed behind the teacher and so shining in the faces of the pupils. Some other states don't meddle, and the architect who is more preoccupied with the design for a monumental or picturesque facade may cut down the window openings. A most romantic boarding school in Connecticut has as few and as small windows as a Surrey farm group, but the classrooms and sleeping quarters must pine in vain for a flood of good, outdoor light! Eye strain and murky interiors have more effect on the body and mind of both pupil and teacher than may be atoned for by the most fascinating craftsmanship and stage setting of the exterior of the school buildings. Indulging a beautiful fad is not a progressive step in education.

Much is demanded in the way of auxiliary units in a private school. Grade for grade, the rooms for drawing and for domestic arts, for manual training and for science, above all for luncheon and for recreation, are usually more cheery and more ample, while the library invites contemplation and browsing rather than suggesting only organized group research and the pursuit of original sources. Such effects are not due to the expenditure of more money on decoration than in the typical public school but frequently to the larger ground area, fewer stories and more rambling plan of the private academy and the avoidance of standardized floor heights. Commercial rooms are notably absent, but music cubicles take their places. Perhaps this summarizes the obvious differences between the expenditure of tax payers' money and the expenditure of donations. In the boarding school or the modern day school where the pupils spend the afternoon, the playrooms and the playgrounds are of particular importance. Yacht model building, printing the school paper, costume designing, wireless experimentation and general tinkering with mechanical gadgets or the crafts of enameling and metal work are all introduced as indoor sports, with the educational features well disguised in the fun of the thing. And whether for boys or girls, there must be space for these pursuits.

The Roxbury Latin School, designed by Perry, Shaw & Hepburn, is an excellent example of the suburban private school of the "country day" type. The grounds are ample to screen the building from the neighborhood and are well planted with trees and



Winsor School, Longwood, Boston
Office of R. Clipston Sturgis, Architects

shrubs and there are playgrounds for organized and for informal sports. Although there is a separate house for the masters, there are no "boarding" pupils and no need for non-scholastic buildings such as dormitories, an infirmary, or a chapel,—departments the planning of which is not specifically identified with schoolhouse design. The original program emphasized a desire for a friendly personality, even requiring fireplaces in all the classrooms, and the building has struck this note admirably. The plan is rambling and this allows a definite coördination into four departments: (1) administration, (2) academic, (3) lunch room wing, and (4) auditorium wing. This further allowed part or all of the building to be constructed at one time. The classrooms have all the same orientation, and their bay windows give to the rooms a sunny informality and to the exterior a charming individuality. The typical classrooms are about 29½ feet in length by 24½ feet wide and are intended for 25 pupils each. The clock tower not only suggests the time-honored tradition of the bell but serves as a semi-isolated stair well and as a centralized location for the ventilating fans. The Georgian style is closely enough allied to the early traditions of the state, and in its free use there are avoided many of the restrictions of Colonial.

One of the minor skirmishes still unsettled between warring groups of pedagogues on the public payrolls concerns the storage and supervision of pupils' outer wraps. Except in the kindergarten and the one-room school, the coat room, *per se,* has gone down in defeat, its floor area being too large and its visibility too low. For the lower grades, the wardrobe built into the classroom wall, with group doors, has the greater number of followers, for it is inexpensive, easy of control and may be well ventilated. For the upper grades, where the classes circulate from room to room, often subdividing and then coalescing again, the "home room" unit is not practical, and the majority of experts favor individual steel lockers, built into the main corridors or grouped in alcoves. On one thing both sides agree:—there must be supervision or security. Not so in the private school, at least in the smaller type; there, wardrobes may be ranged unlocked along the corridor walls, for the idea is to inculcate honesty. In quantity production this is a far more difficult undertaking! In plants which do not have separate locker buildings, the parking space for outside wraps must be generously supplemented by locker rooms, convenient to the gymnasium and to the athletic fields.

The assembly hall and the playroom or gymnasium (the name suits the ages of the pupils) vary in their mutations, but they may be grouped in three classifications: (1) Separate; where the expense is great, but the problem simple. (2) Combined in one; a none too satisfactory compromise and requiring much chair storage space and janitor service. (3) Articulated; that is with the two back to back, separated by folding partitions or heavy curtains, where, in theory, the auditorium seats may be used for spectators of games in the gym and where the gymnasium may be used to enlarge the stage enormously. The separate units are to be preferred, if the size of the school and the need for organized, competitive games justify the expense. After all, the treatment of an auditorium for proper acoustics and suitable decorations is incompatible with washable and rough-usage gymnasium walls and ceilings. A stage suitable for music and theatricals is a poor background for a basket ball goal, and the moving of chairs from storage, setting them up and then replacing them, is not a task which will be lightly undertaken for one evening's entertainment or one morning's address by the headmaster. The "articulated" hall and gym (each profession has its own trick vocabulary) was highly favored in the larger high schools a few years ago, but it has not been

Photo. Paul J. Weber

The Beaver School, Boston

Charles G. Loring, Architect

Photo. Peyser & Patzig

Buckley School for Boys, New York

Simpson & Rolston, Inc., Architects

introduced into the private schools where those with heavy enrollments have land enough and money enough to build separate structures for their athletics and for their assemblies. In some of the smaller boarding schools and in some of the larger day schools the auditoriums are adapted to religious services. In all cases it is well to have the hall so located that it is easily accessible to the pupils for general assemblies or class work and yet with independent doorways so that it may be used without interference with the rest of the plant.

The boarding school group of many buildings, set on the open hillside, or the suburban country day school, with its trees and grassy playgrounds, pictures the private academy at its best and overshadows the rural and small town public schools; but when the pay-as-you-enter institutions of learning come within the congested city limits, their personalities fade; land values restrict their facilities, and the teeming municipal high schools make a far grander show and often are better equipped. Playgrounds are driven to the roof, libraries and lunch rooms are cramped, and even the classrooms sometimes have a much smaller area of floor per pupil. The corner lot is much to be desired, and R. Clipston Sturgis' Brimmer School, with streets on three sides, presents an interpretation which is at once dignified, practical, expressive of its purpose, and economical.

Standardization of the rubber stamp ideal is out of the question in the designing of private schools. In size they may range from the kindergarten of one or two rooms to the long established boarding schools with collegiate plants including guest houses for visiting parents and fraternity houses for the boys. The theory of pedagogy on which they are based may lean toward "the development of the individual" and have no two classrooms shaped or decorated alike, or toward "the development of character" and have a military academy in gaunt barracks. The administration in one school will have all the teaching done in "home rooms" supplemented by a few laboratories and special units; another will have large "study rooms" with many small recitation rooms as well as the auxiliary units. And with the exterior treatment the funds and the fancies of the building committee are the only outside limitations on the architect. The Colonial style is a prime favorite in New England, where education has become almost a major industry, and in Virginia, where children are sent for a modified winter climate and a taste of Southern traditions. The Gothic, especially the domesticated British version, is popular with ecclesiastical schools, and its flexibility in fenestration is a great advantage. In Florida and California the Spanish is the correct thing, and in New Mexico some schools have been constructed after the old pueblos, truly American. With such freedom of action before him, the architect need only coördinate minds of educators, vision of parents, and inarticulate reactions of children with his own technical business and artistic experience in order to undertake the designing of a private schoolhouse!

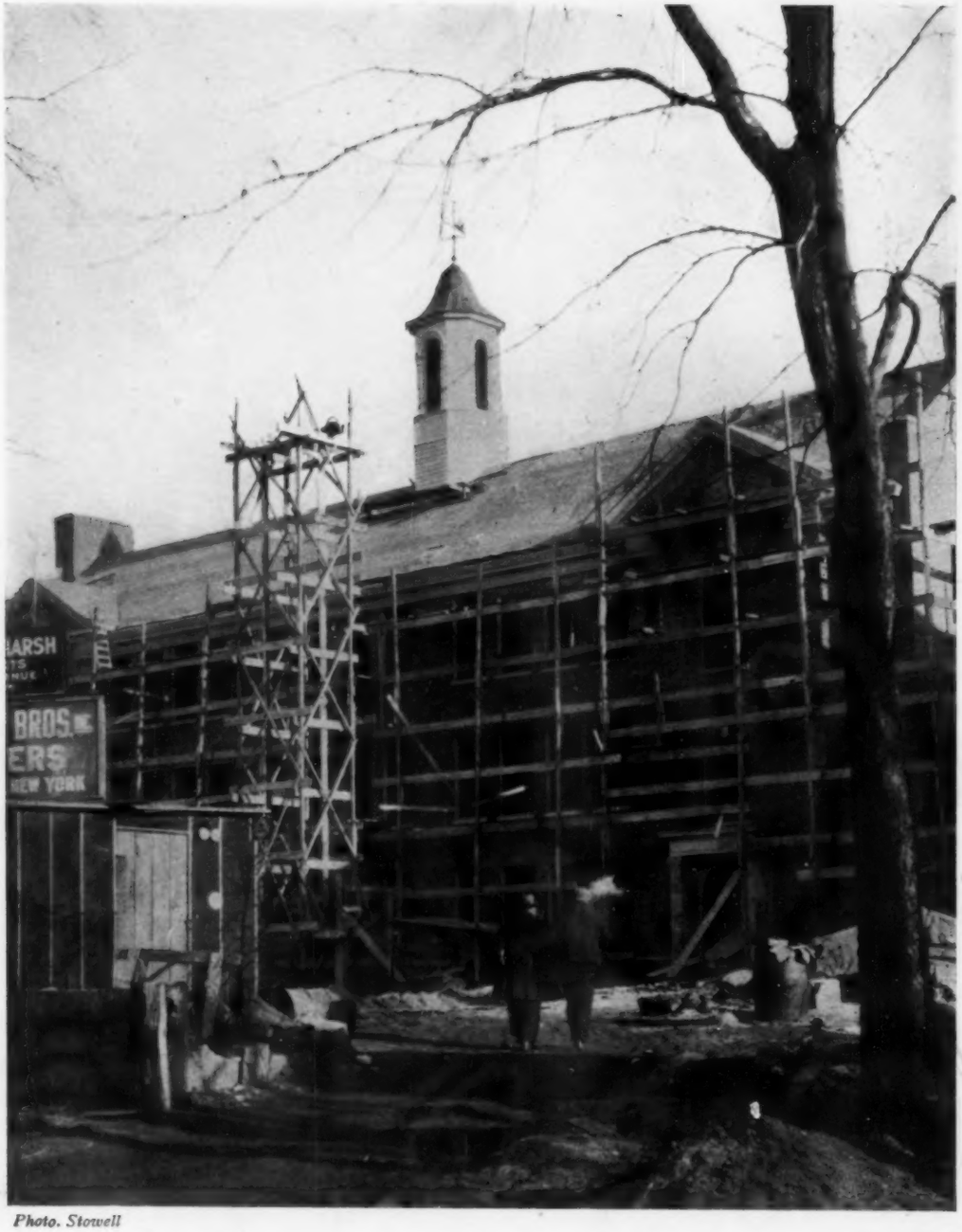


Photo. Stowell

THE SCHOOL NEARS COMPLETION

TUCKAHOE HIGH SCHOOL, TUCKAHOE, N. Y.

Tooker & Marsh, Architects

UNIV. OF MICH.

THE
ARCHITECTURAL
FORUM

VOLUME XLVIII NUMBER THREE

MARCH 1928

THE CONSTRUCTION OF SCHOOL BUILDINGS

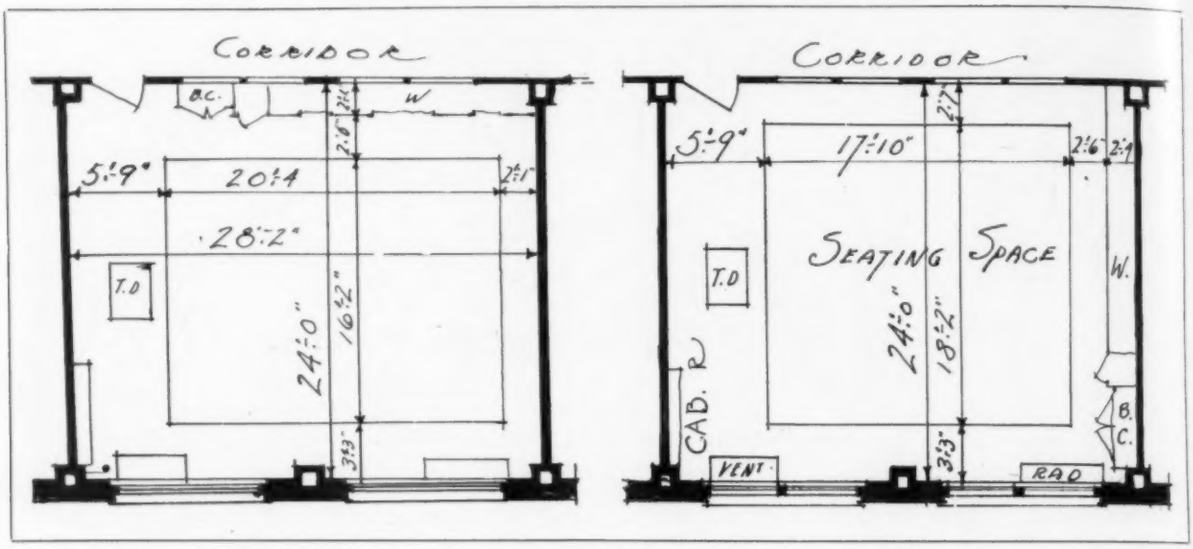
BY
C. B. J. SNYDER
FORMER SCHOOL ARCHITECT FOR NEW YORK

ALTHOUGH all school buildings are intended for the same general use, they present an unusually wide range of construction problems. They vary in size from one to almost 200 rooms, and in height from one story to ten or more. These differences in size are entirely physical, but the character of the scholastic curriculum has an important influence on the construction of a school building. The curriculum usually includes a wide range of subjects, many of which require specific accommodations. The development of and changes in curricula are continuous and sometimes of a decidedly radical nature, and to attempt to envisage their future nature and requirements would be impossible. To provide for new and often radically changed needs requires construction that has a certain measure of flexibility. The correct limitation of materials permits easy and economical alterations and changes in the structure and plans. The architect must consider the possibilities of the site; the required pupil capacity; the amount of money available; the scope and nature of the curriculum; the probability of the necessity of enlarging the building to accommodate an increased pupil population; the probability of there being new and specific requirements for future developments in teaching methods and additions to the curriculum. More remotely, the architect has to consider also the possibility of there being a radical change in the character of the population of the surrounding territory; the intelligence and the ability of the superintendent of schools and the board of education; and public opinion. The factors involved render the designing of a school building a most complex problem.

The operation of a public school might be likened to a production process. The school building should be planned in essentially the same manner as an office or loft building. Suitable facilities for safe entrance and exit of the occupants are essential. In addition, sufficient means of circulation through corridors and stairways is also necessary. With these essentials provided for the safety and convenience of the pupils, the remaining working space should be laid out in such a manner that it can be subdivided to suit general and special requirements as they arise.

Types of Construction. The usual types of construction, from a structural standpoint, used in building schools are the wall-bearing type and the skeleton-frame type. The former usually has brick outside walls and brick bearing walls for the corridors. The floor and roof construction may be of wood, either simple frame or heavier "mill" construction; or light steel or the newer steel trussed joists may be used, fireproofed or not. There are many variations and combinations possible, such as the use of steel beams to support the shorter floor joists, etc. Fireproof construction is not usual in a wall-bearing type of building. Some of the materials may be incombustible or some slow-burning, but fireproof buildings are today practically all of the skeleton-frame type.

Wood and "Mill" Construction. School houses to accommodate a small number of pupils can be very satisfactory when built of wood or standard mill construction, in connection with brick exterior walls and corridor partitions. They can be made entirely safe with certain obvious precautions. The element of fire protection is one of the most important in schoolhouse planning, allied to which is the necessity of providing sufficient means for circulation and egress in case of possible panic conditions among the pupils. Panics may be caused by means other than fire, and if sufficient circulation and exit facilities are provided, fire protection can be safely limited to the construction of fireproof boiler or furnace rooms and the insulation of heating or ventilating ducts and steam pipes. There is little cause for fire hazard in a school building except in these items and in the accumulation of rubbish in basement rooms or closets. Although the wood stud partitions are generally and usually quite rightfully considered a fire hazard, they can be so fire-stopped that with metal lath and plaster they are fire-resistive to a high degree. It is feasible in this type of building to construct fire partitions of hollow tile, made either of clay or gypsum, or solid metal lath and plaster. The only other problems in connection with a mill-constructed school building would be the soundproofing of the floors so that the noise of moving pupils would



Side Wardrobe End Wardrobe

Typical Classroom Plans

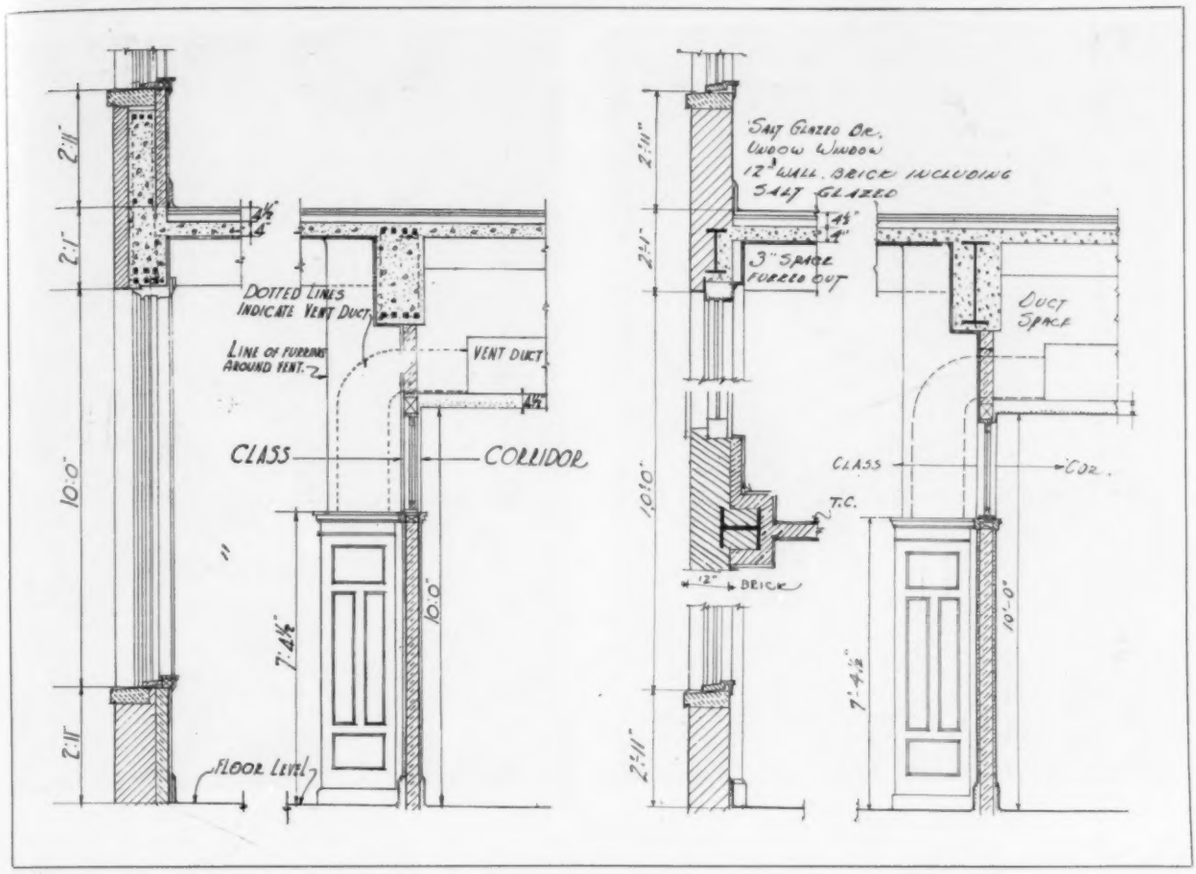
not be transmitted from one story to another. It is not likely, however, that buildings of this type would be more than two stories high. There could be no question whatever about the safety of such buildings if they were equipped with automatic sprinklers.

For the light floor loads common to school buildings, a form of steel construction which consists of light steel trussed or bar joists or pressed steel joists has been found very satisfactory. These are placed approximately 2 feet apart, and on them is laid a thin concrete floor slab with such a finished surface as is desired. The ceiling is usually constructed of metal lath and plaster or a gypsum slab.

Skeleton Frame Construction. Larger school houses are quite commonly built with skeleton frames. These frames are either constructed of structural steel or of reinforced concrete. Hollow tile arches or reinforced concrete slabs are used for floor construction. The type of construction selected is influenced largely by the plan of the building and to a certain extent by the methods adopted for heating and ventilating. The ventilating system often includes vertical ducts which supply air to the rooms and exhaust it therefrom. It is readily apparent that when these ducts are built in the walls between two adjoining rooms they become a permanent structure and cannot be removed to another position without great expense, as this would amount to a practical rebuilding of the ventilating system. When the ventilating ducts are placed along the corridor walls it is possible to remove the partitions between rooms and rebuild them at any desired place. The location of ventilating ducts therefore differentiates the *fixed* from the *flexible* plan. Greater flexibility of plan is secured by placing the main ventilating ducts in the corridor ceilings with openings into the upper parts of the classrooms. If these openings are placed in such a way as to furnish the half-units with the required amount of air, the cross partitions can be placed at will without any interference whatever with the ventilating system. This is perhaps the most flexible plan which has yet been devised for schoolhouse construction.

It is becoming increasingly popular to select the classroom as the basic unit. For this unit two window openings are sometimes provided, which permit this standard unit to be divided in half or to be extended longitudinally to one or more units in length, according to the requirements. In this way it is entirely feasible to plan a schoolhouse without reference to the classroom by merely setting up the limits of the corridors and stairways, permitting the remaining space to be divided into classrooms and laboratories as desired.

The equipment of a modern schoolhouse is such that each lineal foot of wall surface is definitely allocated to some particular use. This wall use is divided between blackboards, various kinds of cabinets, bulletin boards, map spaces and other facilities. In some schools a certain proportion of the wall is utilized for wardrobe cabinets, so that they will be under the constant surveillance of the teacher in charge. Many school authorities prefer this system to the cloak room system, where the wardrobe is entirely removed from the classroom. The wardrobe placed in the school room is saving of floor space because of the elimination of a partition, and the aisle of the school room also serving the needs of wardrobe use. In other words, the area of a partition and an aisle is saved in the plan. In junior and senior high schools where the pupils are not assigned to any particular room, these wardrobes are often placed in the corridors so that they can be accessible without disturbing the occupants of any one room. It can readily be seen that where the walls of the classroom or laboratories are entirely utilized by standard equipment, designed to fit a certain size classroom with a certain size column, an increased size of columns would disarrange this standard equipment and require either a redesigning of the equipment or mak-



Reinforced Concrete Frame — Structural Steel Frame

Typical Sections

ing the rooms larger in order to provide the necessary lineal feet of wall. The type of fireproof construction used results in a minimum or an increased area of ground coverage due to these conditions. The thickness of the exterior wall is affected by the type of skeleton construction used. In one instance a 12-inch wall may be sufficient as compared with a 16-inch wall required by another type of construction. This would naturally affect the extreme width and length of the building a foot or so. The true worth of the structural parts of the school building is established by their comparative strength, durability and adaptability. All of these characteristics should be possessed in the maximum degree. The strength of the materials should be susceptible of accurate determination, not merely based on a theoretical assumption, before they are incorporated in the structure. The materials should possess an enduring strength which does not decrease with age. All materials of whatsoever kind are injuriously affected by exposure to the elements, and this characteristic entails the necessity of protecting them by means of adequate weatherproofing and fireproofing. It sometimes happens that some materials are commonly accepted as unaffected by exposure to air and moisture in combination, or to fire. Observation of their endurance performance under exposure, however, has demonstrated the necessity of providing essential protection.

Adaptability to Other Uses. The adaptability of the structure to new requirements vitally affects its value. This can be secured only by such a plan in combination with structural parts that are susceptible of alterations, removal, replacement or reinforcement. It sometimes happens that the character of a neighborhood so changes that the need of the school ceases to exist. The problem, then, is whether to adapt the building to an entirely new use in order that it may yield a profitable income or demolish it. In the latter case, the cost of demolition and the amount of valuable salvage are important in establishing the sale value of the property.

Comparative Costs. The comparative initial cost of the structural frame does not establish its real value in the structure. A true comparative cost is determined only by making an estimate of cost based on complete sets of plans and specifications for each of the types of construction. Either one may affect the cost of the foundations because of the difference in the dead weight of the structure; the cost of installing the heating, ventilating and sanitary systems may vary; the cost of plastering, carpentry and brickwork may also be affected. These costs can be known only by making careful, individual estimates.

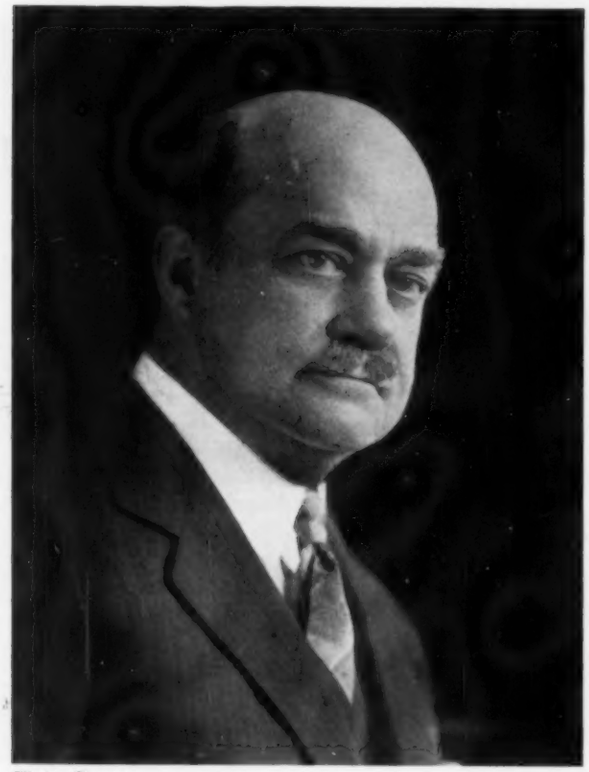


Photo. Strauss

WILLIAM B. ITTNER

WILLIAM BUTTS ITTNER was born, September 4, 1864, in St. Louis. He attended the public schools and the Manual Training School of Washington University, and was graduated as a special student of Cornell University in 1887. Travel and study abroad supplemented his education and enriched his professional preparation. He took up his profession with Eames & Young in St. Louis in 1888, establishing an office of his own the next year. In 1897 he was elected Commissioner of School Buildings for St. Louis, and continued to serve in that capacity until March, 1910, when he was elected architect for the Board of Education, which position he filled until 1916. During the past decade Mr. Ittner has served 59 cities and towns in 24 states as planner and designer of schools. Mr. Ittner initiated and developed the "open plan" in school buildings, which automatically brought about maximum light and ventilation and better design. Aside from his school work, he was architect for the recently completed Scottish Rite Cathedral of St. Louis and many prominent buildings. The A. I. A. elected him to Fellowship, and a medal was presented to him for marked and meritorious achievement in the design and construction of school buildings by the St. Louis Chapter of the Institute, of which he was president in 1895-96. He has served as a member of the board of directors and an officer of the American Institute of Architects. Blessed with an excellent baritone voice and with a genial spirit, he takes great pleasure in music and dancing.

Photo. Potter

JAMES O. BETELLE

JAMES O. BETELLE was born in Wilmington, Delaware, April 1, 1897, where he attended the public schools. He started his architectural career by working for Cope & Stewartson, of Philadelphia. While there he studied at the School of Industrial Arts, and in 1900 came to New York to work for Cass Gilbert. He studied architecture at the atelier of Donn Barber and at other art schools in New York, going to Europe to study in 1905. Returning, he entered the office of John Russell Pope, where he remained until 1910. While with Cass Gilbert and John Russell Pope, he came in contact with Ernest F. Guilbert, and in 1910 they formed the partnership of Guilbert & Betelle. Mr. Guilbert died in 1916. From 1917 to 1925, Mr. Betelle lectured at Columbia University, on "Modern School Buildings and Their Equipment." The course was attended by school principals and superintendents from all parts of the country and from foreign lands, so that his influence on school architecture has not been limited to the buildings he has actually designed. Mr. Betelle believes that architects should render service to the community. Mr. Betelle is now president of the Newark Chamber of Commerce, a member of the North Jersey Transit Commission, and other civic bodies. Mr. Betelle is a past president of the New Jersey Chapter of the A. I. A., and he was elected a Fellow of the Institute in 1927. His hobby is his work, and he seems never to tire, in spite of the fact that he has had but one vacation in four years.

CHECKING SCHEDULE FOR NEW SCHOOL BUILDINGS

BY
JAMES O. BETELLE
GUILBERT & BETELLE, ARCHITECTS

IN order to start the preparation of plans and specifications for a new school building, the architect needs certain information. This information must be furnished him by the board of education after careful consideration and after consultation with the superintendent of schools. It would be of considerable assistance to all parties concerned if the various items on which information is needed or instructions desired could be brought together and listed in a convenient way, in order that they may be considered separately and consecutively and thereby develop the type of building to be erected, together with the materials to be used, and the facilities to be included. Such a list of items is given here, with the hope that it may prove useful to not only the architect, but to boards of education and to superintendents of schools as well. When all the questions suggested in the list have been answered, and the special information requested has been furnished, the architect is in a position to proceed with the preparation of his plans and specifications.

For the information of boards of education and superintendents of schools, it might not be amiss to outline the procedure the architect goes through in making his plans and specifications. The architect first makes preliminary plans and specifications, which he submits to the board of education and the superintendent, for their criticism and approval. Changes can easily be made in these preliminary plans, and possibly the architect will submit a number of different preliminary schemes before a final scheme is definitely decided upon and adopted. Preliminary plans and specifications are just what their name implies, and for the reason that they are preliminary, they can be easily modified and changed. Before approving the preliminary plans, the board of education and the superintendent should give ample time to their study, and the architect will gladly make any desired changes and adjustments in them until they are entirely satisfactory. The time for making changes and adjustments is during this preliminary plan stage, and not when the working drawings are being made or after they have been completed and estimates obtained,—or worse still, during the time when the building is being erected. These belated changes and adjustments cause delay and trouble all along the line, and may mean an additional charge by the architect for changing the completed plans and specifications, and by the contractor if the changes are made while the building work is in progress. From the preliminary plans the architect prepares his contract working plans and specifications, and when they are completed they are usually submitted to the board of education for final approval and authority to advertise for bids, and for sending them out to the contractors for estimates. It is also necessary that the final working drawings and contracts be filed with and approved by the department of education of the state in which the building is to be erected.

While it is the duty of the architect to include in his plans and specifications all the various features and instructions given him by the board of education, it is also the duty of the school board or its representative to know in a general way what the finished plans and specifications include or omit. It is practically impossible for the busy superintendent or the busier school board members to read through the entire specifications and check up everything on the plans, and it is with the idea of simplifying the checking of the plans by the superintendent and board members that this checking schedule has been prepared, which at the same time gives the architect the information with which to start his plans. It is the architect's duty to see that the plans and specifications are complete and agree with each other, and that the state and local laws applying to school buildings have been complied with. Also that the instructions given from time to time by the board of education as to the arrangement, materials or finishes are carried out, and that a complete and substantially safe building is produced when the plans and specifications are realized in brick, stone and mortar. The examination and approval of the plans by the superintendent of schools and the board of education is not made with the idea of relieving the architect of any of his responsibility, but simply to assure the owner that the general instructions given the architect have been carried out.

LIST OF ITEMS

Name of Owner:

Get the correct corporate name of the board of education to be mentioned in the specifications as owner of the proposed building. This is often worded incorrectly.

Kind of School:

Consolidated school?
Grade school?
Junior high school?
Senior high school?
Manual training or commercial high school?
Vocational school?

Organization of School:

Scheme of organization should be given.
Standard or traditional school program?
Platoon, duplicate, or modified "Gary" system?
Number of grades to be taught in the new building?

Capacity of Building:

Total number of pupils for which accommodations are now required?

Number of pupils in various class units? What excess pupil capacity is desired in the building now to be erected?

Rules for Computing Number of Pupils Accommodated in a School Building:

The American Institute of Architects and the Committee on Standardization of School Buildings of the National Education Association have both adopted this method:

> "Compute the number of pupils normally accommodated in rooms designed for classes only. Special rooms are to be figured at the actual number of

pupils accommodated for one class period only. Auditoriums and assembly rooms are to be ignored, but gymnasiums may be figured for one or two classes, as the accommodations may provide. No gymnasiums, however, shall be accredited with two classes, if below 40 by 70 feet in size."

It should be noted that the pupil capacity of a building computed on the basis given here represents a *maximum* capacity. It is not altogether desirable to begin the use of a new school building counting upon such rooms as laboratories, shops and other special rooms as home seats. After the school has been built a few years and before an addition can be constructed, it is often necessary to use these special rooms as home seats or stations for pupils, at which time the maximum pupil capacity will be reached. Pupil capacity can possibly best be stated as "maximum pupil capacity," in accordance with the A. I. A. and N. E. A. rules and upon which the cost per pupil is figured, and "normal pupil capacity," which is the desirable number of pupils any building will accommodate and which represents about 80 to 85 per cent of the maximum capacity.

Scheme of Study Rooms:

Number of study rooms and seating capacity of each?

Storage Rooms for Books and Stationery:

Give desired number, size, and preferred location.

Number and Sizes of Rooms for Different Purposes:

Number of classrooms and pupil capacity of each?

Number and kind of special rooms and pupil capacity of each?

The size of a standard classroom is easily determined when the pupil capacity is settled, the size being dependent upon the number of square feet per pupil required by law in the various states. The size of a special classroom is determined by the number of pupils it is to accommodate in each class, and also by the size and arrangement of the special furniture to be used. A school building should be so constructed that changes in sizes of rooms may be easily made to take care of future educational requirements.

Auditorium:

Total seating capacity?

Number of seats desired on main floor?

Number of seats desired in gallery, if any?

Main floor to be flat or sloping?

Area desired for stage?

Shall stage be arranged for scenery?

Built-in fireproof motion picture booth?

Provision for darkening interior of auditorium in daytime for motion pictures?

Easily accessible for community meetings, or other outside purposes in evenings, or at other times without opening up entire building?

Heating and ventilating systems separate from rest of building so room need only be ventilated when actually in use by a large number of persons?

Will auditorium be used for any other purpose, such as gymnasium or study hall?

Gymnasium:

Size and height?

Accommodation for spectators and number of seats desired?

Will more than one gymnasium be required, or an additional exercise room needed?

Arrangement of locker, dressing and shower rooms, and number of lockers and showers desired in each?

Physical examination rooms?

Physical director's office?

Apparatus storage room?

Gymnasium accessible from outside for community uses without opening main part of building?

Note that minimum size of a standard basket-ball court is 35 x 60 feet; maximum size, 50 x 90. A space of at least 3 feet should be allowed all around court.

Swimming pool?

Library:

Size and preferred location?

Number of books at present in school library and probable maximum number in future?

For school use only, or also a circulating library?

If circulating community library, provision should be made for its use outside school hours, evenings and holidays, also provision for heating without running main heating plant.

Library stack room?

Library work room?

Library may also be used to advantage for teachers' meetings and school and community club meetings.

Laboratories (Physics, chemistry, biology, general science, etc.):

Kinds of laboratories?

Number, size, and preferred locations?

Number of pupils to be accommodated at one time in each?

Equipment?

Lecture Rooms:

Number, size, use, and preferred locations?

Seats on raised platforms?

Pupils to be accommodated in each?

Equipment?

Special Rooms:

Number, size, and preferred locations of all special rooms, such as:

Bookkeeping,	Sheet metal shop,
Stenography,	Forge shop,
Typewriting,	Printing shop,
School bank,	Agriculture,
Music rooms,	Machine shop,
Domestic science dept.,	Kindergarten,
Laundry,	Mechanical drawing room,
Model apartment,	Freehand drawing room,
Sewing room,	Arts and crafts room,
Men teachers' room,	Museum,
Women teachers' room,	Janitor's room,
Girls' rest room,	Principal's office,
Medical inspection rooms,	Superintendent's office,
Dental clinic room,	Board of education rooms,
Playrooms,	Bicycle room,
Woodworking shop,	Secretary's office.

Give number of pupils to be accommodated in each at one time; approximate size and preferred location of each room; also description of special equipment and accessories.

Lunch Room and Kitchen:

Provision for preparing and serving lunches to scholars and teachers?

Number of pupils to be seated at one time, and preferred location of rooms?

Types of Wardrobes and Method of Taking Care of Pupils' Clothing:

Wardrobes in rear of room?

Separate cloak rooms adjoining classrooms?

Steel lockers built in along corridor walls, or in alcove rooms off corridors, or elsewhere?

Any other special arrangement desired?

Provision for Extension of Building to Take Care of Future Growth:

Buildings should always be designed so that additions can be easily built. It is recommended that a future addition be actually drawn out on the preliminary sketches for future reference. Later boards of education can then see what was contemplated in the way of an addition when the building was planned, and whether they follow it in all its details or not, they at least have a basis on which to start work.

Money Available:

For building .....$.....
For driveways, paths and grading property..$.....
For architect's fees.....$.....
For furniture and equipment.....$.....
Surplus for contingencies.....$.....
Total .....$.....

When It Is Desired to Have School Building Completed:

It must be remembered that for a medium-sized building it takes from two to three months to prepare plans and specifications, and from ten months to one year or more to build the school, depending upon its size.

Survey of Property:

It is the duty of the board of education to furnish the architect with a complete topographical survey of the property. This survey should give dimensions, levels, show streets, locate all trees and existing buildings, gas mains, water main, sewers, electric mains, and kind of current available; also any peculiar features of the property, or any restrictions applying to them.

Test Borings:

The board of education should have test borings made or

test pits dug to determine the character and bearing capacity of the soil; also to locate the level of sub-surface water, and the location of rock, if any. Neglect to determine the character and depth of the underlying soil has many times been the cause of great expense later on, when the construction of the building was under way.

Work to Be Included or Not Included in Contract:

Are lighting fixtures to be included or purchased later?

Is entire property to be graded, or only just around building?

Are roads, paths and sidewalks to be included?

Is the architect to include the handling of furniture and equipment or any special items?

Temporary Facilities While Building:

Decide who furnishes and pays for water, light and heat, used during the construction of the building,—the owner or contractor?

Investigate cutting down of certain trees within the area of new building and the boxing around or protecting of those trees which are to remain.

Removal of any old building on site and disposal of old material? Is it desired to save any old materials?

Insurance of Building During Construction:

The board of education usually insures the building against fire and tornado during construction, for the benefit of all parties concerned, as their interests may appear at the time of loss. Liability insurance and damage to persons or property is carried by the contractor.

Method of Making Payments to Contractors:

This is usually done monthly, upon certificate of the architect, and equal to 85 per cent of the value of labor and material actually incorporated into the building at the time of calculating payment. The remaining 15 per cent accumulates as a final payment, which is generally made within 30 days after completion and on acceptance of the building by the owners.

Book Lifts, Dumbwaiters, Dust Chutes:

If any are required, number, size and location should be given. Vertical shafts and doors to them should in all cases be fireproof.

Wainscoting in Corridors and Classrooms:

Lower walls of classrooms, and especially corridors, are subjected to heavy wear and abuse. Wainscoting of painted burlap is often used in classrooms, and of glazed brick about 5 feet high in corridors.

Sound Deadening of Floors or Partitions:

Certain floors and partitions, such as the floor of a gymnasium, where located over an auditorium, or a toilet room adjoining a classroom, need to be insulated and have sound deadening. There may also be other cases where such sound deadening is required, as, for instance, around music rooms, gymnasiums, noisy shops, etc.

Waterproofing:

What measures have been taken to make walls and floors of rooms below grade waterproof?

Do soil conditions make a tile sub-surface drain necessary around building?

Materials or Appliances to Be Used in the Building:

Materials and trim used on exterior?

Building of fireproof or semi-fireproof construction?

Kind of floor construction?

In a fireproof building it is assumed that all floor construction is fireproof, although the roof construction is sometimes built of heavy timber to save money. In a semi-fireproof building it is usual to make the corridors and stairs fireproof, and also floors and ceiling of boiler room and manual training room fireproof. Other construction of wood.

Materials of roofs?

Kind of wood for inside trim?

Kind of wood for classroom floors?

Kind of floors in corridors?

Kinds of floors in miscellaneous spaces?

Kind of floors and wainscoting in toilet rooms?

Type of windows,—double-hung, hinged, or special type?

Kind of stairs?

Spaces where wall or ceiling, or both, are not to be plastered?

Ash lift or other provision for getting ashes out of boiler room?

Are outside woven wire window guards required for protection of windows on lower story?

Any folding iron gates across corridors desired to cut off certain portions of building when auditorium or other rooms are being used at night?

Any iron fence desired around playgrounds and rest of property?

Any fireproof record vault required?

Bolts for window cleaner's belt on outside of all window frames above ground floor?

Kinds of blackboards and their location?

Cork display boards in classrooms and bulletin board in corridors?

Any folding or rolling partitions required between classrooms?

Are partitions between toilet fixtures, wood, metal, soapstone, slate, etc.?

Bookcase and teacher's closet in each classroom?

Metal-covered doors to boiler room and manual training rooms, closing them off from corridors and basement?

Metal-covered partitions and doors glazed with wire glass enclosing staircases and acting as a smoke and fire screen?

Special locks for special rooms, such as principal's office, laboratories, etc.

Key system for various rooms and master key for all doors?

Metal numbers or card holders on doors to classrooms?

Panic bolts required on all outside doors?

Any spring checks desired on outside or inside doors to keep them closed?

Plaster walls painted, and where?

Painting of brick walls, and where?

Painting of cement floors?

Lettering of doors to various rooms?

Special decorative painting of auditorium and main entrance hall?

Quality of glass used in outside windows?

Quality of glass used in exterior and interior doors?

Obscure glass used in such places as toilet room windows, shower and locker rooms, etc.?

Wire glass for fireproof partitions, doors, and stair enclosures?

Plumbing:

Location and size of water main, sewer, and gas main?

Any apparatus for hot water? Kind, size and location?

Locations of fixtures to be supplied with hot water?

Is plumbing a cast iron or screw pipe project?

Disposal of rain water on surface of ground or into sewer?

Pipe covering on hot and cold water and steam pipes?

Connections on outside of building for water hose?

Are fire line stand pipes and hose reels desired in corridors?

Type of plumbing fixtures. Number of fixtures usually fixed by regulation of the state department of education.

Location and number of drinking fountains?

Sewerage disposal plant required where no sewers are available?

Inside cast iron rain water leaders from roofs or outside sheet metal leaders?

Any laundry tubs desired in connection with domestic science room?

Any pipes running through cold air rooms or any unheated spaces should be carefully covered to prevent freezing.

Any gas outlets in corridors, stairs, auditorium, etc.?

Provide gas outlets in laboratories, lunch room, domestic science room, boiler room, teachers' room, etc.

Electric Work:

Obtain full information as to the kind of current and its phase and voltage furnished by the local lighting company, together with location of service connection.

Number of lights in classrooms and control of them?

Any outside lights at entrance?

Base receptacles where needed?

Electric outlets for special furniture in laboratories, demonstration tables, etc.

Outlet for motion picture or stereopticon machine?

Footlights and overhead lights for stage?

Location of program bells and how operated; by a program clock or hand push-button?

Electric power outlets for motors, fans, etc.?

Outside door push-button ringing bells in front corridor and boiler room?

Special program bells in noisy rooms?

Push-button and buzzer from stage to stereopticon location?

Fire alarm bells and their location? How operated?

Bells, telephones and clocks operated by dry batteries or storage batteries?

Long distance outside telephones?

Any interior telephone system? Location of central switchboard for interior telephone system?

Number and location of interior and outside telephones?

Number and location of secondary clocks in classrooms which are operated by master clock in principal's office?

Locations of master clock, program bells, switchboard, fire alarm switchboard, telephone switchboard?

Any electric outlets required for electric irons or electric stoves?

Kind and design of lighting fixtures?

Is electric service wire from street main run exposed overhead on poles or concealed in conduit below ground?

Heating and Ventilating:

Type of heating system: one-pipe, two-pipe, vapor or vacuum system?

Are fans to be used for either or both the fresh air supply and exhaust ventilation?

Type of boiler or furnace?

Kind of boiler grates,—stationary or shaking grates? Kind and size of coal to be burned? Oil-burning boilers in certain localities?

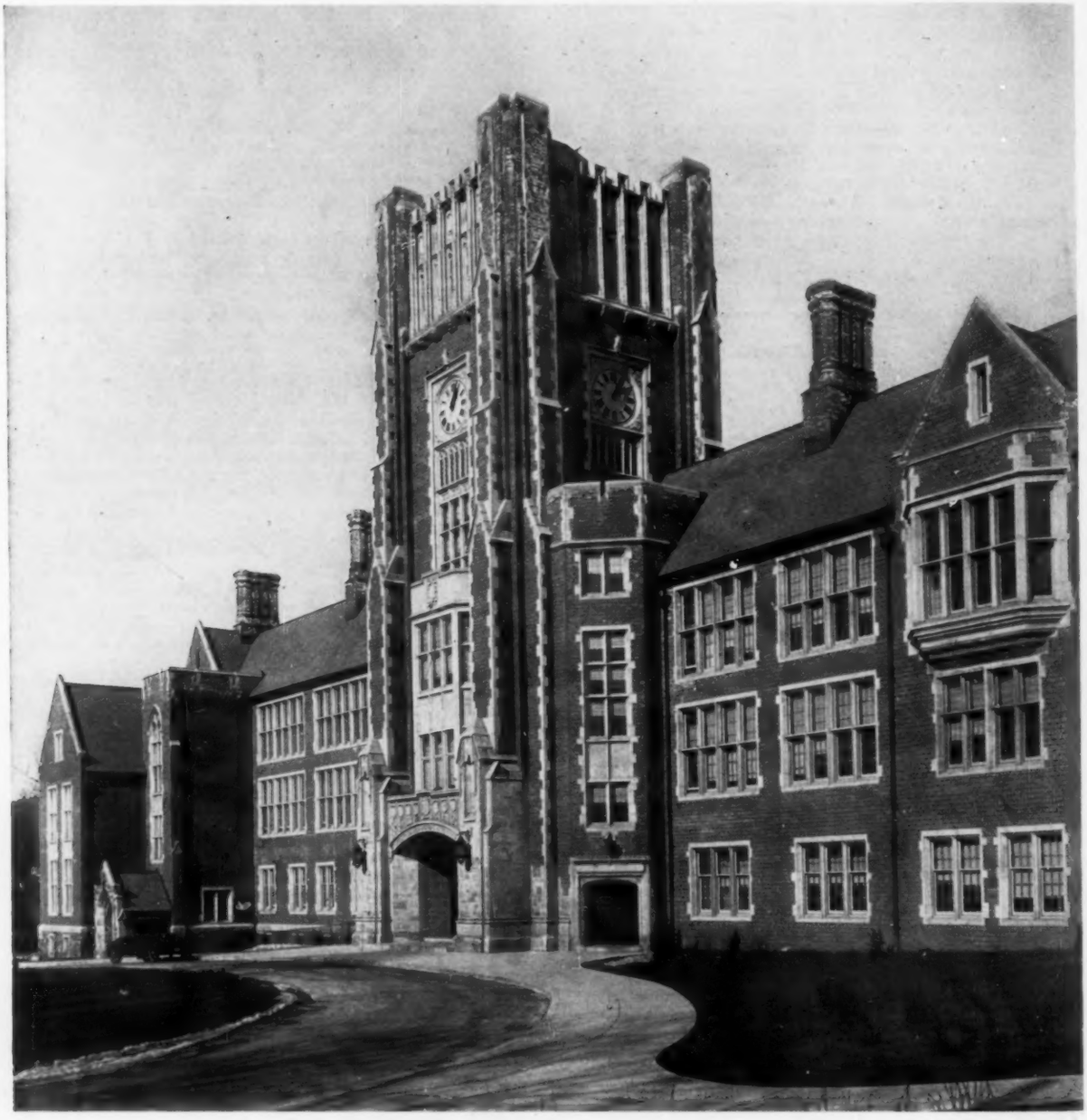
Special provision for heating principal's office, board of education rooms, superintendent's office during winter holidays and evenings, so entire building will not have to be heated?

Is automatic temperature control called for? What sections are so controlled?

Special ventilation for toilet rooms, independent of school ventilation?

Piping system to be valved for separate control of direct radiators in classrooms, auditorium, etc., and for indirect air heaters for ventilation? Also sections of building to be shut off in case of accident to any part of system?

Classroom and auditorium heating and ventilating controlled separately, so that either section can be used without the other?



Tower, High School, South Orange, N. J.

Guilbert & Betelle, Architects

SPECIAL ROOMS IN HIGH SCHOOLS

BY
DWIGHT H. PERKINS
PERKINS, CHATTEN & HAMMOND, ARCHITECTS

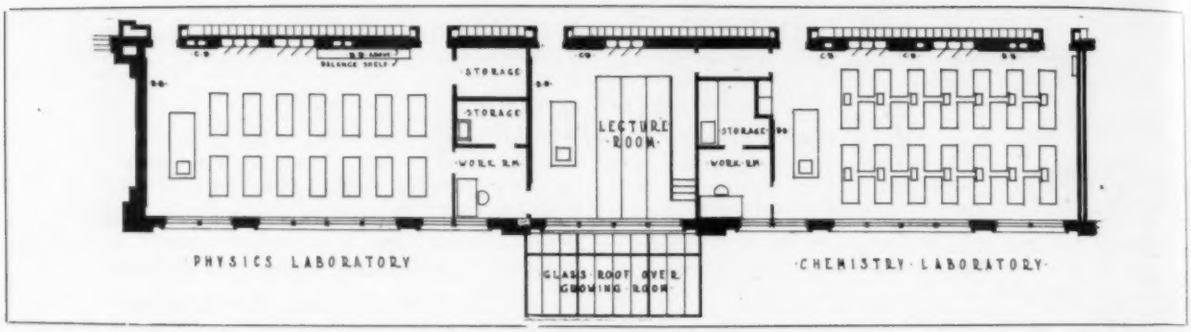
PROGRESS in education necessitates constant change in schoolhouse planning. This constant change is due not only to change in the requirements in order to carry out certain newer methods in the teaching but is likewise due to very rapid increase in the high school population. Whatever may have caused this increase in high school population, we have it with us and it must be provided for. School boards are further embarrassed by having thrust upon them the problem of erecting more buildings at a much higher unit cost. The reaction to this very simple problem of providing more buildings for more pupils at enormously increased prices has caused the demand for the strictest economies in floor planning. In the good old days when a high school building meant classrooms of large proportions with an occasional room designated the "laboratory," and another the "library," there was no particular need for research and study of methods for economy; but nowadays, with seating shortage prevailing in almost every school district in the country, and with boards of education bewildered because of no available funds and very serious restrictions as to the measures for increasing their funds, everybody,—architect, school administrator and members of the board itself,—is vitally interested in every measure which will conserve space and at the same time not interfere with the full opportunity of the student and the convenience of the instructor. Unfortunately, this last item has been given little attention. No business corporation would employ high salaried people such as are employed in our modern high schools and handicap them from day to day with a non-workable, unproductive environment.

It is with this situation in mind that this discussion of special rooms is undertaken. The special rooms have become a large factor in the high school. Academic rooms in a modern high school seldom exceed 50 per cent of the number of the total units provided for the operation of the school. In a recently planned high school for 1200 pupils, it was found that only half of the total recitation units to be provided were actually classrooms. In addition to the recitation units, there is required the usual office space, as well as study halls, library, lunch room, gymnasium and assembly hall, all of which may come under the designation of "special rooms."

Laboratories. Within recent years, there has been developed for use in laboratories special equipment built around the necessity for conserving space, adding to the convenience of the pupil, and giving some attention to the administration of the room as a teaching unit. The most recent development in this field is a series of tables connected back to front through the center of the table by a narrow compartment through which the plumbing and other service lines are laid. A part of this narrow compartment is used for storage; in some instances, bottle racks; in others, the less frequently used apparatus. This scheme has some points in its favor, particularly in chemistry, where the disposal of waste has always been a very definite problem. By utilizing this scheme, the sewer line can be brought to one point above the floor and then be carried under the floor slab to the corridor wall without disfiguring the ceiling of the room beneath the chemistry laboratory with unsightly pipe lines and their occasional leakage. The plan of this type of table is shown in an accompanying drawing for the chemistry laboratory. (Page 426). The further advantage in the use of this table is that with only slight inconvenience it can be used for other laboratory work, such as physics, biology or general science. Its fundamental weakness is that it requires a low height if used for other purposes, and, consequently, pupils are generally seated, occasionally with attached chairs, which makes more numerous opportunities for accidents. The pupil at a chemistry table requires for his own safety and convenience at least the opportunity to stand while working. The second criticism is the lack of circulation for the instructor, which is an essential where individual instruction is considered fundamental.

Another type of recent development in laboratory equipment is the two-pupil table, which is coming more and more into favor, because it does provide for the concentration of two pupils on one problem, for the utmost freedom in supervision, and for the the ready adjustment of the room in providing for additional pupils. For use in physics and biology, as well as for general science or other laboratories where plumbing is not a major requirement, this two-pupil table is a distinct contribution. It is in marked contrast to the old six- or eight-pupil table set full width of the room, except for an aisle at each end and usually requiring that half the pupils face the other half. Only the extreme necessity for conserving space can justify the utilization of this old type of multiple-station table. The two-pupil table has another distinct advantage, in that its equipment is easily modifiable to suit the individual projects for all succeeding occupants. If properly equipped, the modern school occupies all of its recitation units every period of the day, which means that the science laboratory is used by four different classes each day, and on alternate days by another four.

Placing Equipment. It is essential that full consideration be given to the best utilization of the space available. It should be remembered that pupils spend most of the time at the work tables, and therefore it is essential that tables be given first call on



Laboratories, Lecture Room, Growing Room and Services
Senior High School, Fort Smith, Ark.
Perkins, Chatten & Hammond, Architects

the best light of the room. In many old laboratories everything except the pupil's table is close to the light, placing the pupil's table on the dark side of the room. For instance, the balance or microscope table is frequently placed under the windows, with the presumption, obviously, that it should be near the light. Modern artificial light is so efficient and so easily provided and these units are used so seldom that we recommend placing these tables on either the rear or corridor wall of the laboratory. The instructor usually objects until he sees how it works.

In a chemistry laboratory, fume hoods are a necessity, but generally a nuisance. If the fume hoods can be located before the structural plans are determined, confusion and expense can be avoided by proper location of vents. In order to get positive exhaust of these fume hoods, the installation of small fans, which, by the way, will improve the ventilating of the whole room, should be made in the vents. Various experiments are under way now for the installation of fume hood facilities on the pupil's desk itself. No doubt this will become a practical device in due time, but as yet we are not ready to accept this idea. It requires much more expenditure than would seem justified for satisfactory operation.

One of the most constant sources of annoyance in all laboratory work is lack of the proper storage for notebooks. Various schemes are being used. Recently the notebook rack has been heralded as the solution for the evil, but in actual operation, the notebook rack is an invitation to copying and petty annoyance. Some protection should be given to the pupil by providing cabinet locks for each class using the racks. It may be the occasion for a little additional expense or inconvenience in distribution, but it saves in the long run those annoying circumstances which so frequently arise in the conducting of the class. Under certain circumstances, office files, each section locked separately, have proved useful.

Ample bulletin board spaces for the posting of announcements or display of excellent work are a great convenience. These should be placed near the most used exit, as should also the file cases or notebook racks. A very limited amount of blackboard is sufficient. A folding blackboard in 4½-foot sections, so that the work of each class may be retained without interfering with that of other classes, is the most serviceable. It costs more to install in the original layout, but it leaves space for other purposes.

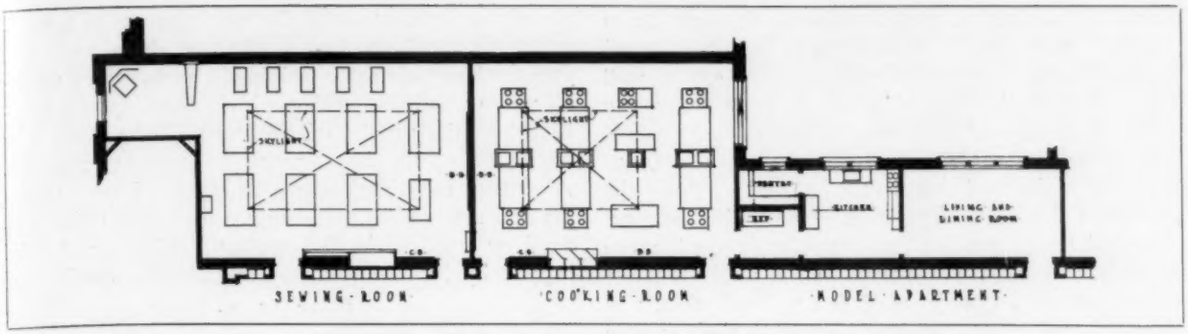
Care of Equipment. It is the duty of the architect to provide for the best care of all equipment. It is a remarkable fact that neglect costs more than the actual use of certain apparatus. To place the storage area in some dark corner, frequently in a segregated place, is to insure rapid deterioration because of neglect of the apparatus. Whatever the architect may do to provide for this care, only the most persistent effort on the part of those responsible for the school's administration, will guarantee the proper use of facilities. The architect should assume the responsibility for making this care a possibility.

Accessories. In addition to the regular laboratory space, every suite of laboratories should have well equipped lecture rooms so placed that they may be used to supplement more than one laboratory, and so organized that they will be easily accessible from the private workroom of the instructor. In biology, much confusion is saved by providing growing rooms or greenhouses in connection with lecture rooms.

The accompanying plans proposed for the Fort Smith, Arkansas, High School illustrate most of the measures which have been suggested. We should note, however, that the faculty of the school prefers to use the two-pupil tables in the chemistry department, because of added convenience, and such has, therefore, been planned. The biology laboratory is on the first floor immediately under the physics laboratory; and classrooms, planned for conversion into an additional biology laboratory, should it become necessary, are beneath the chemistry laboratory. The physics laboratory was not needed for full time, and therefore provision was made for extra storage room, so that this laboratory might be used to supplement the one biology laboratory for which the demand was temporarily out of proportion.

Girls' Shops

The cooking room is one of the hardest units in the whole building to plan. There are two major



Sewing Room, Cooking Room and Model Apartment
Senior High School, Fort Smith, Ark.
Perkins, Chatten & Hammond, Architects

types of plans. Incidentally, it might be said that those responsible for the operation of this unit are quite positive in support of whichever plan they favor. The older plan is that which became so common some 20 or 25 years ago, when cooking was being generally adopted as a school activity. This consisted of a hollow square, open at one end, furnishing a place where materials could be prepared and cooking operations be conducted either by the pupil individually or by the instructor as a demonstration. It had its advantages, many of which cannot be continued in the newer type of organization. It was cheaper. It gave the instructor an across-the-table contact with the individual pupil with a minimum traveling distance. It had the disadvantage of forcing too many pupils into very limited space.

Recently, there has been developed the so-called "unit" plan, wherein a sample kitchen is built for each two, three or four pupils. Its adherents claim for it the advantages of simulating home conditions. Some of its opponents have pointed out that there is only one cook at home with about twice as much space as that usually devoted to two students in the school, and that the reproduction of home conditions is far from actual. Others seriously question the necessity for an attempt to reproduce the home environment. Somewhere in between the two extremes is the sound middle ground upon which most teachers will finally come to an agreement. As between these two extreme viewpoints, the poor architect does not dare make a choice. If he plans for one type, the other will be wanted within a short time, because the change of teachers in this department is usually due to a change in the opinion as to the proper method of securing results. It is not at all impossible, however, for the architect to provide a distribution of his units in such a way that segregation into individual compartments may be inexpensively provided, or vice versa. Insofar as it is possible, the equipment used by pupils should be common to each station in a cooking room. This lessens the confusion in getting materials and is conducive to continuity in developing any given project. As in other laboratories, provision should be made for adequate storage space of frequently used apparatus, and a compact but easily accessible filing space for notes. One of the most common faults in this particular laboratory is the omission of space for the storage of aprons or other clothing which should be worn by the students while engaged in this activity.

The accompanying plan is not quite illustrative of the point in hand, because we had the distinct advantage here of a room lighted with a skylight. However, it does illustrate the possibility of providing space for small groups with sufficient segregation for good operation. This is on the same principle as that defined in the planning of the laboratories for this same school. The somewhat unusual floor plan of the cooking room was developed by the faculty of the school after much study of the problem and the discarding of many suggested plans.

Sewing Room. As this room does not require fixed equipment to any considerable extent, great freedom can be exercised in its planning. The equipment has usually consisted of sewing tables fitted with individual drawers for the maximum number of pupils using this room. However, as the schools have become crowded and the requirement for full-day use of this unit has developed, it has become practically impossible to provide so many drawers of adequate size in an ordinary sewing table. The tendency now is to use a very simple table with an open space provided for the placing of separate trays, which take the place of the drawers. These trays are individual and are cared for in stacks with locking devices or doors. The proper distribution of these trays is a simple matter, but it seems to have become objectionable to some people who have had difficulty in organizing the procedure. The minute of confusion in the distribution of these trays is fully compensated for by the greater amount of working and storage space which each individual pupil has, and therefore, better opportunity to organize her belongings. The sewing room should be provided with display space as well as storage space. It has been found advisable to segregate these two because the front of the storage space cannot be kept organized for display purposes, and if the display space is used for storage, it is always out of order.

Where both sewing and millinery courses are of-

fered, the school can very readily use the same room for both purposes if, in addition to the main room, a small room is provided with storage space, well equipped with shelving. One of the most frequently misused features of equipment of the sewing room is a triple mirror. These are not only expensive, but they are easily and frequently broken. Taking the cue from the large department stores, the architect will find that a much simpler device is much more efficient. Setting one mirror on the wall with one side extended from the wall line a few inches, and then using one other mirror hinged to the opposite wall or else on a movable frame, gives an efficiency fully equal to that of the triple mirror.

Placing sewing machines in disappearing cabinets improves the appearance of the room and leaves the well lighted portion for the work tables. In general, the equipment of this room can be simplified and made more efficient by a careful study of the best practices in our large department stores.

Model Apartment. The home-management or home-making courses offered in our schools frequently lead to the building of a model apartment within the school building. This may seem to be an extravagance at first thought, but when one remembers the many purposes for which such a space may be used, the expenditure can be justified. Where nothing more can be provided, at least the kitchen and dining room should be built in close proximity to the cooking laboratory. The accompanying diagram of the Fort Smith, Arkansas, girls' shop illustrates well how the two may be coördinated. For instance, the refrigerator which serves the cooking laboratory, is a part of the kitchen in the model apartment. Frequently, the appearance of the model apartment has been ruined by the use of a ceiling height equal to that of the regular classrooms. This is not necessary, and should be avoided.

Small School Requirements

We who have been planning school buildings for large urban centers have almost completely lost sight of the problem confronting our neighbors in the smaller communities. A very large percentage of our high school children are housed in schools where the number of pupils does not justify the provision of all of the facilities ordinarily found in our larger high schools. This should pique the interest of the architect and the school man to develop a combination which will be effective and inexpensive. A plan of a combined laboratory and household arts room accompanies this article. (Page 430). It shows how, by providing separate storage space for the materials and apparatus of chemistry, for physics, for household arts, etc., the same room may be used for all purposes. It is essential that separate units be vented. Many other combinations, of course, could be made for this type of combined laboratory. The equipment would consist of a plain, easily modified table; even a separate top for this table might be provided when it is used for chemistry. Of course this does not meet all of the requirements of a modern laboratory, but some of the best chemists in this country had their early training in a laboratory where all waste was handled through the medium of a half-barrel in the middle of the room. The farm boy needs his chemistry as much as does anyone else. A similar combination can be made of commercial art and mechanical drawing rooms. It is pitiable to see how students in the smaller districts are handicapped by lack of thinking in terms of combining.

Boys' Shops

Wood Shop. This department has become quite standardized. For the lower grades, say the junior high school, the standard form of work benches together with a simple saw, and possibly a sanding machine, are generally accepted as sufficient. For senior high schools and trade schools, more equipment is necessary. Teaching through production requires modern industrial machinery. One of the main problems in these wood shops is the care of tools, which are used by successive groups throughout the day. We are recommending an accessory room where an individual tool kit equipped with all the cutting tools required in this work can be stored. This requires a little more time for distribution, but it saves enormously in the time spent with poor tools because somebody else was not responsible for their care. These individual kits can be placed in sections which can be locked, thus avoiding borrowing. Everyone takes greater pride in that which is his own. The school's investment is not materially increased, because the individual set of tools for each pupil gets less proportionate wear in the long run because of its more particular care. The space required for these tools is not expensive when properly organized. A very simple method is to provide storage space to the ceiling with an iron stair and platform at convenient height. If this scheme is used, the old-fashioned tool room can be reduced in size or eliminated.

Auto Shop. The auto shop is the most variable of all shops that have been provided in our schools. It is essential that it may be entered from the street. Outside of this there is nothing in common in the general practices throughout the country.

Electric Shop. To teach the electrical trades in a high school, it is necessary to have quite adequate space. There is a growing tendency to combine this with the auto shop, and to confine the instruction in principles to the physics laboratory. However, as electricity has come more and more into common use, the trade schools especially have required a segregated shop for teaching purposes. In the electrical shop, much shelving is required. It is shallow, however, and simply means that the architect provides wall shelving in small narrow compartments. Deep bins and drawers should be had only in limited number.

Print Shop. One of the most serious problems in laying out a print shop is the securing of adequate light. Natural illumination in a print shop is less

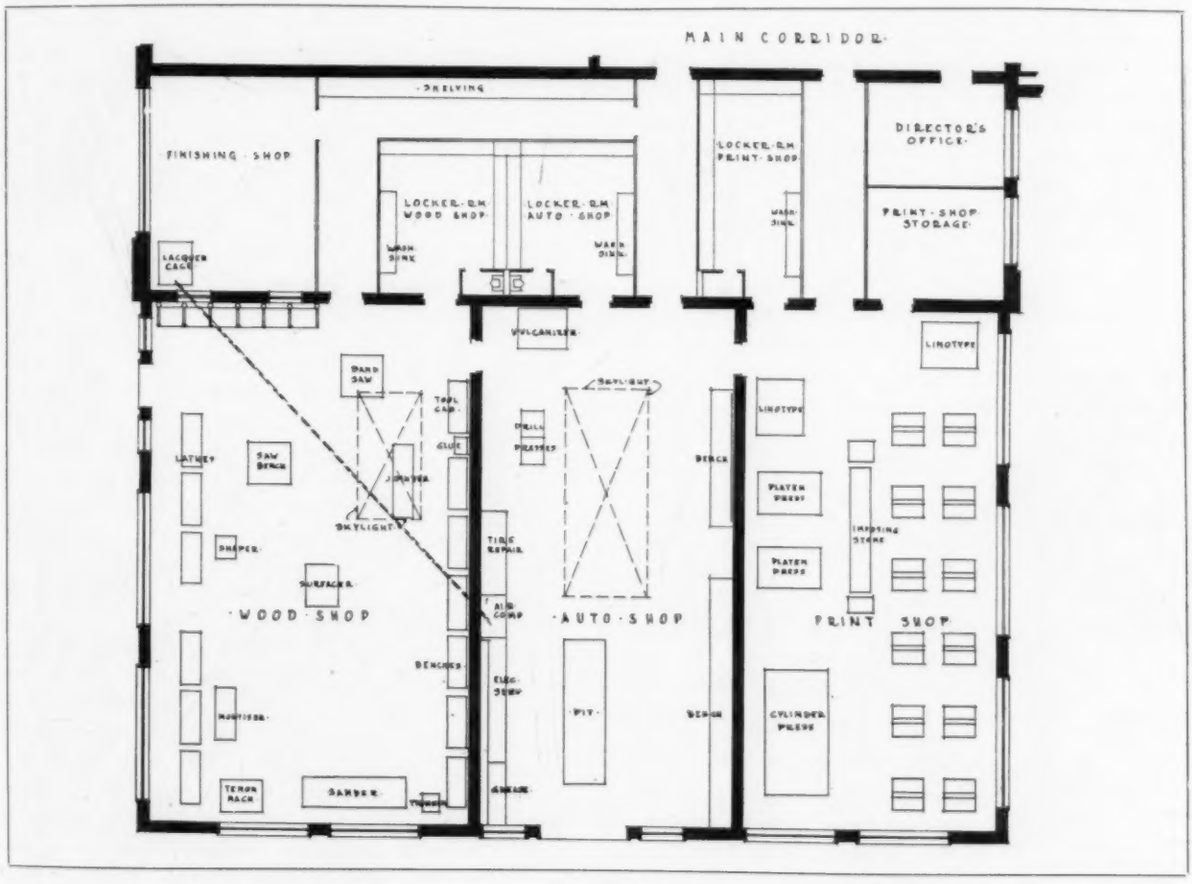
practical than in any other place in the school. The work is such that it requires adequate artificial light. and therefore it is not objectionable to use some space which has shortage of natural light, and thus definitely depend upon artificial light. To equip a print shop in the school as a commercial shop is necessary only where advanced courses are given, or where full-fledged journeymen are trained. The problem confronting the architect is to get the school to definitely define its limitations in this field.

Sheet Metal. To give adequate courses in sheet metal work, only a very limited amount of space is necessary. It is not essential to do work on large units. The principles involved can be taught with very simple equipment, and by the use of small projects. Probably the most effective organization is found in a shop with a well equipped 30-inch, counter-high table underneath the windows. For this purpose, a bilateral lighted room is desirable. The space underneath the bench can be organized into storage space; the corridor side of the room can be equipped with shelving for display of projects and the housing of tools, equipment, etc.

Locker Rooms. In our boys' shops, it is quite essential that adequate locker space and washing space be provided. Most boys like to remove their ordinary clothing and change into working clothing before going into the regular daily exercises. This is one of the essential reasons for the increased size of the shop unit, so as to provide this locker and dressing room space. A simple equipment consists of a double tier of lockers about 10 x 15 x 36 inches, one compartment for each boy in the maximum sized class, and basket racks for the storage of work clothing, one compartment for each boy taking the course.

Mechanical Drawing. It is well to locate the mechanical drawing room near the shops, because of the general articulation of the work in these. Mechanical drawing supplements shopwork. Shopwork should not be undertaken without definite drawings. To motivate mechanical drawing, it is essential that these principles should be recognized. Adequate artificial light must supplement the best natural light obtainable. It is almost impossible to secure adequate natural illumination at all times. Many prefer north light for this purpose, but well regulated skylight is equally valuable.

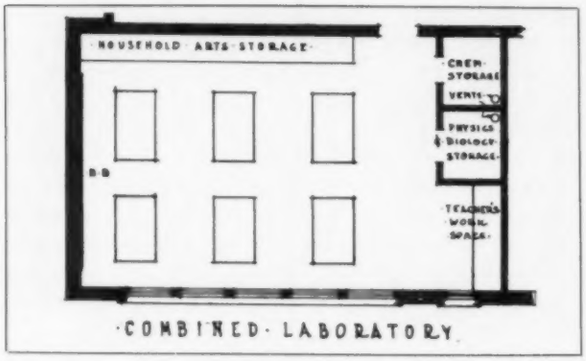
The equipment of the mechanical drawing room requires great care. Too often its utilization is limited by the number of individual compartments in the pupil's desk. In order to get more compartments in a desk, the space for each pupil has often been re-



Shop Unit

Senior High School, Fort Smith, Ark.

Perkins, Chatten & Hammond, Architects



Laboratory for Small School
Perkins, Chatten & Hammond, Architects

duced until it is hopelessly inadequate. The compartments should conveniently hold full-sized drawing kits and drawing boards with unfinished work attached. Extra classes to any desired number may each be served by a locked cabinet with the same compartments as those built into the desks. The instructor's table should be equipped with large shallow drawers for the storage of materials and drawings, and if many pupils are housed, this should be supplemented by a separate cabinet. Ample tack board and display rail for presenting subject matter or displaying finished products are essential. Very little blackboard space is needed.

A blue-print room should be incorporated in, or adjoin the mechanical drawing unit. If the blueprint room is well equipped, it can occupy a very limited space and yet be thoroughly efficient. It does not need outside light, and therefore, it can frequently be provided out of space undesirable for regular classroom purposes.

Art Rooms

What has just been said about mechanical drawing, applies equally well to the art room. This room must, for its best operation, be proportionately large, because it is necessary to have much open space in the front of the room, or, where movable furniture is used, in the center of the room. The art room should have running water, preferably in a sink with ample drainboard space. Running water in an ordinary wash bowl is almost useless. In addition to the requirements for the storage of large materials and individual kits and drawing boards needed in the mechanical drawing department, the art room requires much space for apparatus and its more varied materials. A generous sized room left to be equipped as needed is a great convenience to the art department.

Music Room

Probably no other one factor has contributed more to the shortcomings of the American people in the development of an appreciation and production of good music than has the handicap of inadequate space with which the American teacher has been required to work. The assembly hall is still the music room in many schools, and it is a rare teacher who can get results in this environment. In the first place, it invites overloading of the classes. In the second place, it is frequently unavailable at the regular class periods; and finally, the proper care of materials is an impossibility. A unit where music and dramatics can be equally well housed has much better possibilities. An oversized classroom,—as much as a unit and a half,—fitted with a small stage or platform, having adequate storage space, and located so that it can be segregated from the rest of the building, gives a much better opportunity for doing those unusual things which must be done in order to produce the best results. The use of the top story for this unit adds something in the way of isolation. In large high schools, a top story consisting of the music and possibly the radio departments only, is quite feasible. Where the music department must be provided for on the same floor with other units of the school, a simple scheme for isolation is to build all of the storage space on the wall or walls adjoining the other units. If this amount of storage space be not needed, it does not add greatly to the expense of the building to have a dead air area provided by furring out some distance from the wall.

Commercial Department

The proportion of the building needed for this department varies so extremely in different communities, and for that matter at different times in the same community, that planning for future expansion becomes essential. This can be done by planning classrooms with no unusual equipment adjoining the commercial department in sufficient number, so that practically an unlimited expansion is possible.

There is a distinct advantage in planning the commercial department as one unit. However, administration on adjoining floors near a stairway is less difficult than it is to have widely separated units on the same floor. There are only a few new movements in this department which require the special attention of the architect. The outstanding one of these is the replacement of the old method of bookkeeping by the machine method. Numerous electrical outlets, giving a maximum of flexibility in arrangement of the room, is less expensive than continuous alterations in order to get this flexibility later.

Bookkeeping. In bookkeeping, the utilization of the room is too frequently lessened by the number of drawers in the desk adopted. Six drawers seem to be about the maximum that can be provided, yet the school is called upon to organize as many as eight or ten classes in this subject. This can be done by providing a vacant space in the desk where the drawer or other container for the pupil in the extra classes can be placed while he is working. Cabinet space will house the extra drawers when not in use by the pupil. The individual lighting of desks may prevent eye strain, but care should be taken to prevent light from one desk reaching other desks.

Typewriting and Stenography. The teaching of typewriting and stenography may be combined in one room for advanced courses. The first courses in each of these should be given in separate rooms to avoid duplication of equipment which lies idle in a room housing both courses. In the typewriting room, ample file cases will make it possible for each pupil to learn something about filing, and at the same time keep a record of his own progress. The self-appraisal of one's own work in this subject makes for progress. In both the typewriting and the stenography room, a folding blackboard with tack board and display rail increases the efficiency of the room.

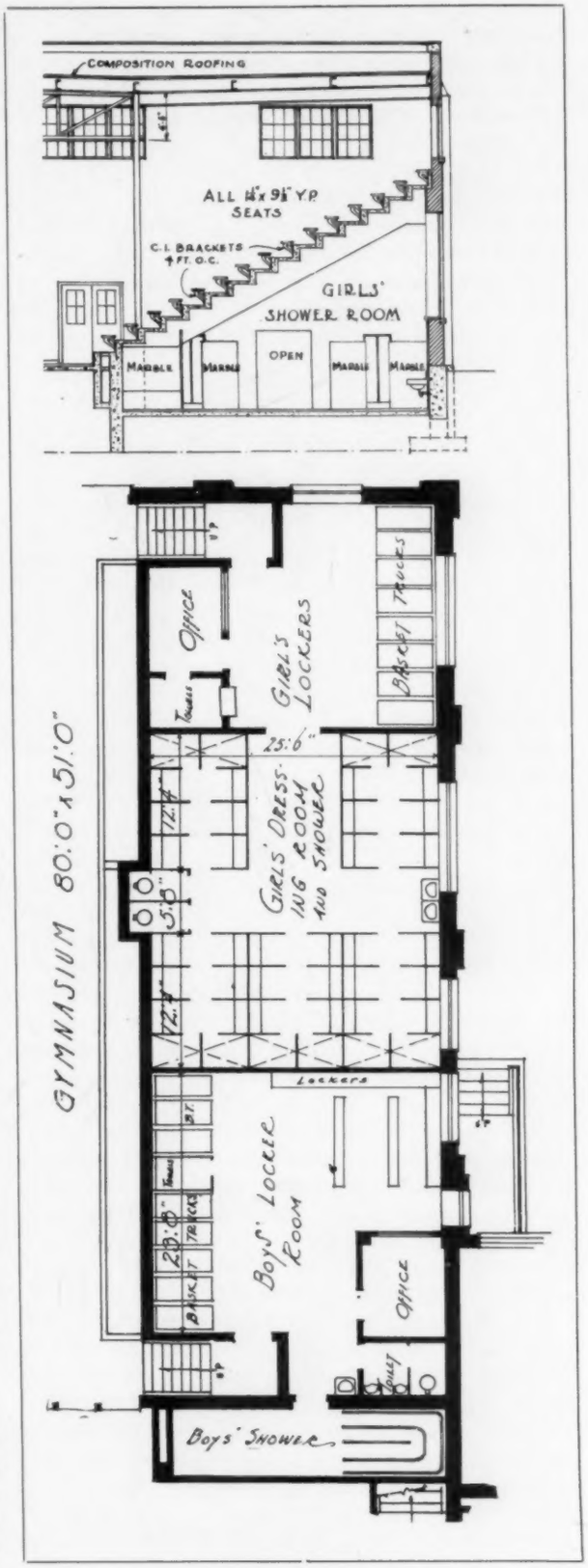
Library and Study Halls

The major features of a high school library are quite different from those of a public library, yet there are times when the same quarters may be used to house both, the public library being operated out of school hours, and, if necessary, its books being distributed to high school pupils only during regular library hours. The community use of this portion of the building is usually at its peak in other than school hours, so that there is no necessity for increasing the seating capacity of the reading room much beyond that demanded by the school. There is a general feeling among librarians, not shared fully by school people, that all libraries should be on first floors, because of better access. In planning buildings, to put the library on the top floor is a distinct advantage, because both sides of the corridor and the corridor itself can be combined in one unit without expensive structural features. This distinct advantage is lost when the library is put on the ground floor.

The school that utilizes study halls as a part of its program has an excellent opportunity to develop self-reliance and individual power in its pupils, if the school assures the pupil of the equipment,—texts, materials, etc., which may be necessary to keep him profitably occupied when he finds himself without assignment sufficient to take the full period in the study hall. A few copies of every textbook used and the most generally used reference material should be easily accessible to every student in the study hall. Book shelving, material racks, dictionary stands, and some deep bins for storage of materials, will aid the school administration in carrying out such a program. If the library is kept close to the study hall, additional advantages arise. Every pupil should form the habit of using the library before leaving the school.

Gymnasiums

There are some changes taking place in the attitude toward equipping the gymnasium. One of these is the demand that it be treated as a playing space, equipped for basketball, volley ball, and similar games, but not equipped with the numerous devices for individual exercise, which are infrequently used. These devices do have a place in the school program, but their use should be restricted to a small corrective department. They clutter up the appearance and



Plan of Locker and Shower Rooms, with Section Showing Seating Above

Senior High School, Fort Smith, Ark.

Perkins, Chatten & Hammond, Architects

the use of the main gymnasium. Locker and shower space can easily be placed beneath the bleachers or seating space if this be concentrated on one side of the playing floor. The relative merit of this scheme, as compared with placing seating on both sides of the playing floor and housing the shower and locker room in another part of the building, varies in different communities. Where the cost of construction of cement seating space, which is the only fireproof form of construction feasible, is very much cheaper in narrow sections, it sometimes becomes less expensive to forget the space beneath it, and to provide the shower and locker space in light construction adjoining the gymnasium.

The Lunch Room or Cafeteria

From the early high school lunch room, operated by the struggling household art department, to the present-day elaborate cafeteria, operated on a strictly commercial basis, was a long jump. Perhaps the planner of high school lunch rooms can do no better than to keep closely in touch with the commercial development in this field, and incorporate for his client the best ideas produced. The equipment has been thoroughly standardized and is briefly discussed elsewhere. The chief problem in current planning is how to make use of the lunch room floor area at times when not in use as a cafeteria. The high school administrator begging for more room is tempted to make use of this space for purposes for which it never was intended. Here is where the architect serves his purpose. In developing a plan, dual use should be kept in mind. Two questions arise. The first is, "Why must the whole unit be one open space?" This is a universal demand, based upon ease in supervision, but which is subject to considerable criticism. The second is, "What device is best for segregating the unit into smaller units for classroom or other purposes?" Folding partitions, roll curtains, light screens, have all been tried and found wanting. Will not someone, with more daring than the rest of us, plan a dining room with the outside, well lighted area divided into approximately standard classroom sizes by permanent partitions, and let us see how it works? Some extra doors in these partitions would facilitate the use of the recitation units for lunch room purposes. I believe this would be superior to any attempt to use movable partitions.

The size of the lunch room is an important factor. School administrators are inclined to underestimate the number of pupils who will demand service when a new project is being introduced in a community. Considerable expansion of the use of the lunch room can be made by extending the number of lunch periods. Many pupils are ready to eat their lunch at 11:30, and 30 minutes seems to be long enough in most schools. By using three 30-minute periods, pupils who do not take lunch at school can usually be given two of these periods, which automatically increases the range within which it is possible for pupils to go home for their lunch.

Assembly Hall

If an assembly hall is to be used for bringing the whole school together, as was originally intended, then our problem is almost insurmountable. With high schools quite commonly having as many as 3,000 pupils, the assembly hall becomes an institution equaling in size a commercial theater. Ex-superintendent McAndrew of the Chicago schools claims that the assembly halls should be built primarily for educational purposes, and that, therefore, it is large enough when it seats a sixth to a fourth of the student body. Incidentally, this meets practically all of the requirements for community purposes. It is quite seldom that a community demands seating quarters for a greater number than this. The standard argument in favor of the larger assembly hall is the need for seating at graduation time. This seems to be a habit rather than a necessity. Commencement exercises are not necessarily most desirable when a larger group is present. The essential elements to be incorporated in an assembly hall are three in number. First, the acoustics should be perfect. This makes it possible for the student with ideas but limited voice to be heard. It also makes it possible to utilize the hall for classroom purposes, particularly, dramatics and music. Second, it should be an attractive, pleasant place to meet. Dull, uninviting quarters are not conducive to the easy, free development of ideas, which is one of the essentials in our social life, and which the school should foster. Third, the seating should be convenient and comfortable.

Offices

It may be stretching the definition of a special room to include the offices as such, but so much of the success of the school depends upon good planning of the central offices, that I have chosen to include it here. Good office planning requires the recognition of a few fundamental principles of office management. First, one must know the interrelationship of the agencies to be housed. The principal of any high school is a busy person. He should, for this reason, be able to reach any of his subordinates with a minimum of effort. This precludes the segregation of the office suite into separate units by spacious hallways or corridors. Second, the equipment of the office should provide ample storage space easily accessible for all materials to be distributed to the school. Storage of large quantities may be provided at some distance from the main office, but the office itself should contain space enough for current supply. Third, good lighting, good ventilation and heat which may be made available when the school itself is not in operation, fosters good administration. Fourth, school administration has rush seasons. Planning a room adjoining the offices, so that it becomes available for the temporary assistants during these rush seasons, is an easy matter. The planner of school buildings owes it to the school to give it an office where efficient management can be maintained. He owes it to the taxpayer to avoid undue expansion.

STANDARD ARRANGEMENTS OF SCHOOL CAFETERIAS

BY
A. E. MERRILL
EQUIPMENT ENGINEER

THE accompanying plans represent standard arrangements for school cafeterias, and were adapted from actual installations in the central portion of the United States, where probably the largest number of schools have been so equipped.

Number of Patrons. In determining the space that is required for the particular school, it is customary to assume that approximately 40 per cent of the total enrollment will avail themselves of cafeteria privileges. Furthermore, as this equipment is to be used but once a day, it is always advisable in the larger schools, where there are 1000 or more pupils, to divide them into two or more shifts. A logical division is to have the girls come in at one time and the boys come in at another.

Counters. Even with such a division, there will often be more than could be conveniently handled by the maximum service counter in one shift, and in such cases, the arrangement shown as Outfit "D" is doubled, and two or more identical service counters are installed, preferably paralleling the walls separating the dining room from the kitchen. If space does not permit of such an arrangement, these counters are arranged in horseshoes with two services to each such division, extending vertically from the kitchen wall into the dining room.

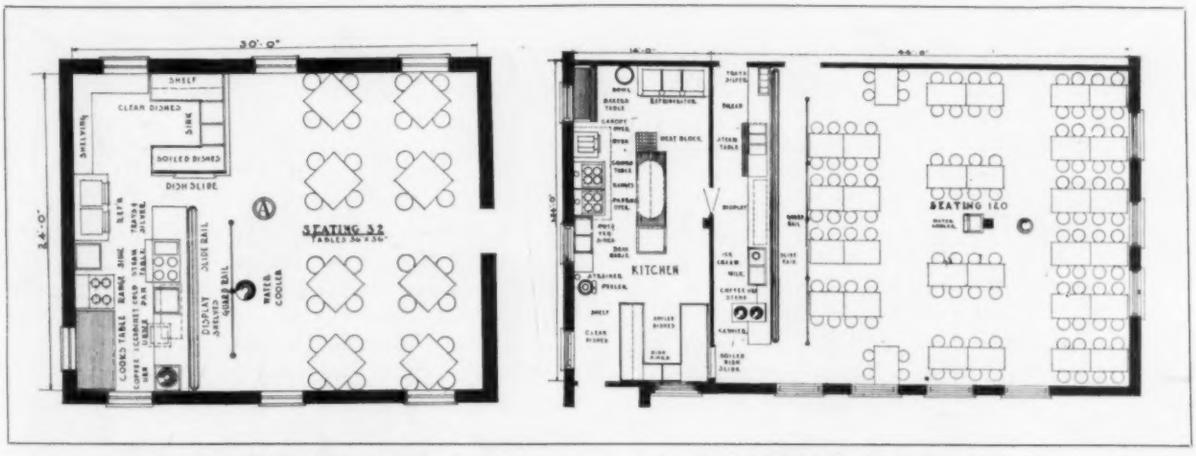
Pupils per Counter. Thus, taking an actual case as an example, a school of 1000 pupils, where at least 400 would be expected to use a cafeteria dining room, could be handled by one service counter and dining room, as shown in Outfit "D," providing the girls and boys used the room at different times. Whereas, if the school had an enrollment of from 1600 to 1800, it would be necessary to at least double this counter arrangement and seating capacity, even though the pupils were separated into divisions.

Time for Service. It has been found by experience that under normal conditions it is impossible to serve students more rapidly than at the rate of 12 or 13 per minute; consequently, if 200 pupils are to use a dining room at once, it would be approximately 15 minutes from the time the first was served until the last one had been taken care of.

Seating Capacity. In order that seats may be assured for all the pupils after they leave the counter, it would be necessary to have at least 175 chairs provided for this length of counter, and the extra seats on the plan "D" are for those who will bring their lunch and not require counter service.

Outfits. The various plans indicate different types of table arrangement. Outfit "A" shows 36-inch square tables, diagonally placed through the dining room, which gives more freedom of space than any other arrangement, but is more expensive in floor space required, as at least 14 square feet per seat is necessary. Outfit "C" used 30 x 48-inch tables, placed end to end, and this type of arrangement is most economical of space, as it requires 12 square feet or less per seat, including counter service.

Type of Equipment. In selecting the kitchen equipment and dining room equipment, a wide range of qualities are available, and in the summary which is given here it is a standard serviceable variety, which is not ornate or elaborate. These prices may be lowered by at least 25 per cent for the cheapest or may be doubled if a particularly fine place is desired. Galvanized iron sinks are included and, with the exception of Outfit "A," glass-top tables are used. Where a wooden-top table and bentwood chair are used, the tables and chairs together may be secured for as little as $5.50 per seat, whereas when a glass-top table with a better grade of chair is se-



Plan, Outfit "A," Open Kitchen Type for Smallest Cafeterias

Plan, Outfit "C," Kitchen Separated from Serving Table

Open Kitchen Type, Similar to "A"
High School, Pelham, N. Y.

Cafeteria with Two Units Similar to "D"
High School, Asbury Park, N. J.

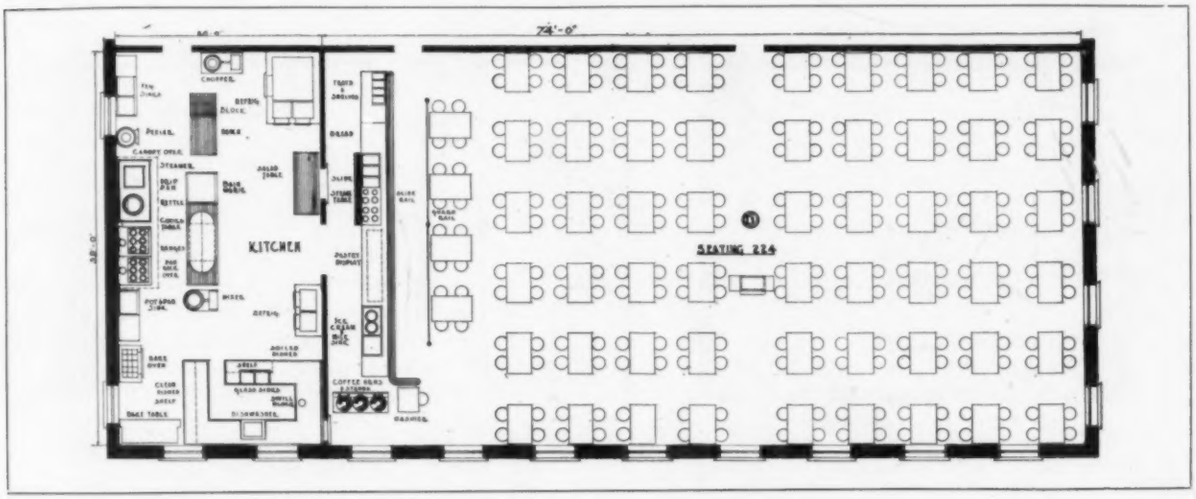
lected, the cost per seat may run as high as $15 each.

Power Machinery. The use of power machinery is recommended in Outfits "C" and "D," including in the latter a vegetable peeler, mixing machine, meat chopper and dishwashing machine, all of which labor-saving devices are an economy in operation. If any of these were to be eliminated, the dishwasher should be the last to be considered, as for sterilizing purposes alone it is practically a necessity. Only those types using the overhead spray should be given consideration, the type in which the dishes are held in racks, over the washing tank.

Electric Refrigerators and Refrigeration. No electrical refrigeration is included in the cost summary, although this is specified in the majority of the larger installations, and it adds only about $400 for each box of 75-cubic foot capacity or thereabouts. All refrigerators are figured with sheet cork insulation, and all boxes should be adaptable for the use of either ice or mechanical refrigeration.

COST ESTIMATES

Outfit "A," seating capacity of 32:	
Serving Counter and Equipment	$550
Cooking Department	410
Dishwashing	150
Tables and Chairs	220
Utensils and Trays	250
	$1,580
Outfit "C," seating capacity of 120:	
Serving Counter and Equipment	$1,850
Cooking Department	1,650
Dishwashing	200
Tables and Chairs	1,500
Utensils and Trays	650
	$5,850
Outfit "D," seating capacity of 224:	
Serving Counter and Equipment	$2,600
Cooking Department	4,000
Dishwashing	950
Tables and Chairs	2,600
Utensils and Trays	1,150
	$11,300



Plan, Outfit "D," Efficient in Plan, Equipment and Arrangement

RECREATIONAL AND ATHLETIC FACILITIES IN SCHOOLS

BY
JOSEPH C. LLEWELLYN, ARCHITECT

THE part which recreation and athletics play in schools of the higher educational organizations of the country today, as compared with the same work in schools only a few years ago, forms an interesting topic. Not very many years ago, in order to get a gymnasium into a school building without a great deal of opposition, it was necessary to camouflage it as a playroom, recreation room, or something similar,—the word "gymnasium" being not wholly understood. But with the playroom actually provided, its use became more clearly understood; it was extended and supervised, and the gymnasium grew into being. Whether the facilities provided are used to the fullest advantage may be a topic for discussion, but it is certain that the activities in this field of school life can be made useful in promoting health, in building character, and enabling boys and girls to get on with their fellows in after life. The adaptation of recreation and athletics so as to build and maintain good health and good character is the part of and is in the hands of the nation's educators, and we believe they are equal to the responsibility. It is the work of the architect to provide the housing and facilities with which to do the work to the best advantage, and to do this work well he must acquaint himself with the educators' viewpoint as fully as possible.

In the limits of this article it is possible to give only an outline of the essential requirements, and that in terms of the average present-day school, such as is found in the smaller cities and community groups. Briefly, the topic can be divided into two general heads: 1st, provisions for indoor athletics, including the gymnasium and the necessary locker and shower rooms and other accessories, and the swimming pool; and 2nd, provision for outdoor athletics and recreation.

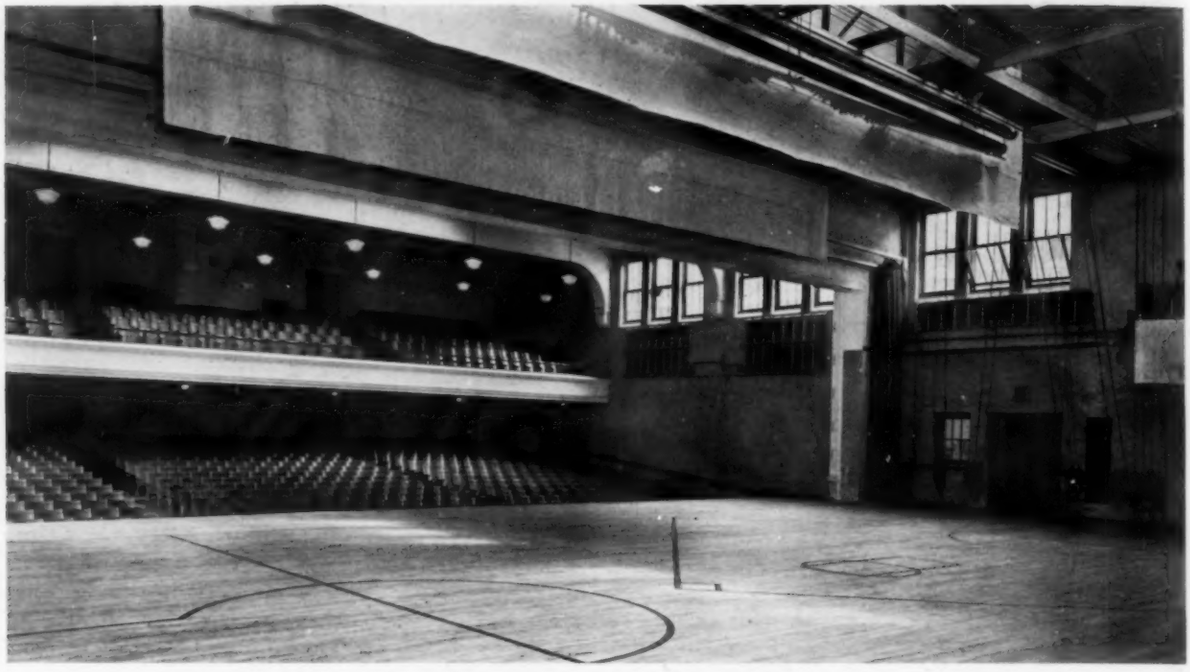
Originally, any rectangular room having a width of 40 to 50 feet, a length of 60 to 70 feet, and a height of 16 feet or more, would class as a gymnasium. Shower facilities were meager, seating space for the public absent or very small, running track and straightaways for the most part absent. Public interest grew, however, and facilities for witnessing the games became necessary. This necessity, together with the necessity of economy, led to the use of many plans looking to the double use of floor space, as, for instance, a corridor converted into a visitors' gallery by the installation of movable windows between the corridor and the gymnasium; the double use of the same floor space for an auditorium, when provided with movable chairs, and a gymnasium when chairs were removed,—a small stage being provided at one side of the room. These and similar arrangements have their drawbacks as they necessitate the use of removable chairs or bleachers.

The Stage-Gymnasium and the Auditorium. As athletics became popular the auditorium also came into more general demand, and the stage-gymnasium, in which the stage of the auditorium is enlarged to gymnasium proportions, with a proscenium practically the full width of the auditorium, came into use. The auditorium was provided with fixed seats, thus eliminating the storing and moving of chairs every time the occupancy changed, and it became possible to use both gymnasium and auditorium for different purposes at the same time. Improvement in the constructions of accordion doors of light construction and sound-resisting materials has made it possible to reduce to a very considerable degree any interference with the work of either gymnasium or auditorium by the other. The stage-gymnasium in conjunction with the auditorium having fixed seats is an economical arrangement for schools of medium size,—say of from 750 to 1,000 pupils,—and it is well liked by many who have used it, although the first reaction may have been one of opposition.

In large schools, and where funds are available, the arrangement will give way to a wholly separate auditorium and stage, and to separate gymnasiums for boys and girls. In some instances, the stage gymnasium is used by the girls and a separate gymnasium by the boys, the latter without bleachers or seating for the public, as all contests and athletic entertainments, exhibitions, drills, pageants, etc., are given on the stage-gymnasium. The tendency, however, is for larger gymnasiums and larger playing floors to permit more than one class to work at the same time and thus provide for growth in school enrollment; and to have permanent seating accommodations for an average audience, with movable bleachers for expansion upon special occasions.

Gymnasium Essentials. The essentials of a gymnasium are, 1st, a good floor, level, smooth and resilient; 2nd, smooth, hard walls for 10 to 12 feet above the floor and, above this wainscot, plaster quite porous to diminish sound reverberation; 3rd, sufficient height to accommodate the desired apparatus; 4th, permanent seats for average attendance at games, and provisions for caring for special occasions; 5th, shower and locker accommodations; 6th, good light and ventilation in gymnasiums, locker rooms and showers; 7th, other rooms such as coaches' offices, storeroom, workroom, special corrective gymnastic rooms, and rest room facilities for girls.

The floor for the majority of gymnasiums is maple, a serviceable floor when laid with proper care upon nailing strips supported on felt-lined screeds to give resiliency, with the nailing strips anchored to floor at intervals. Proper provision must be made for the expansion of the floor in damp weather. A fine playing floor is obtained by using blocks of yellow

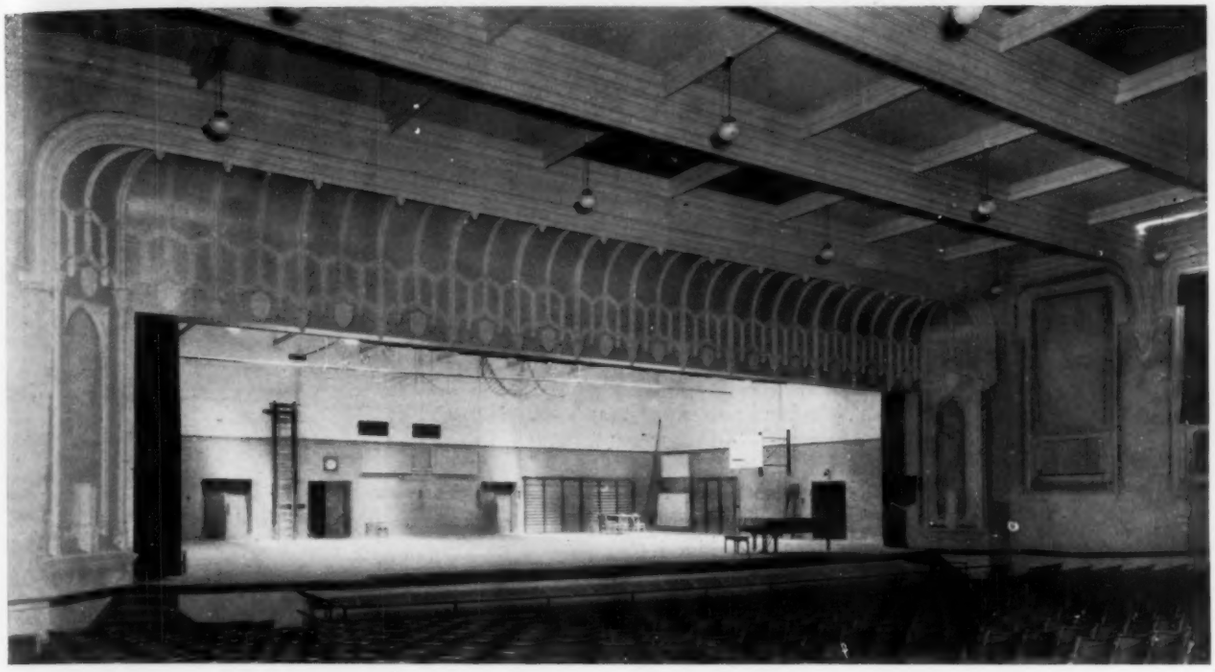


Stage, Combined Gymnasium and Auditorium, Community High School, Dundee, Ill.
Joseph C. Llewellyn Co., Architects

pine on end, glued to strips, then grooved and splined, and secured to nailing strips brought to true level. Wood floors should be sanded and treated with penetrating oil, placed with mop and left to penetrate the wood. Floors of short wood, laid herringbone or in small squares in mastic and sanded and treated as before, have been used in a limited way. Also a mastic top on a ¾-inch base of asphaltic concrete has come into use. It has the advantage of neither shrinking nor swelling, is easily repaired, and, in the case of basement gymnasiums especially, is well worth considering.

Walls of smooth, impervious, matt finish face brick laid with smooth flush joints for a wainscot 10 or 12 feet high will resist wear and tear. The ceiling should be covered with a sound-absorbing material. Heights of rooms will be governed by conditions, and must be sufficient to care for all suspended apparatus (usually 22 to 24 feet), and to provide clearance for running track, when installed, so as not to

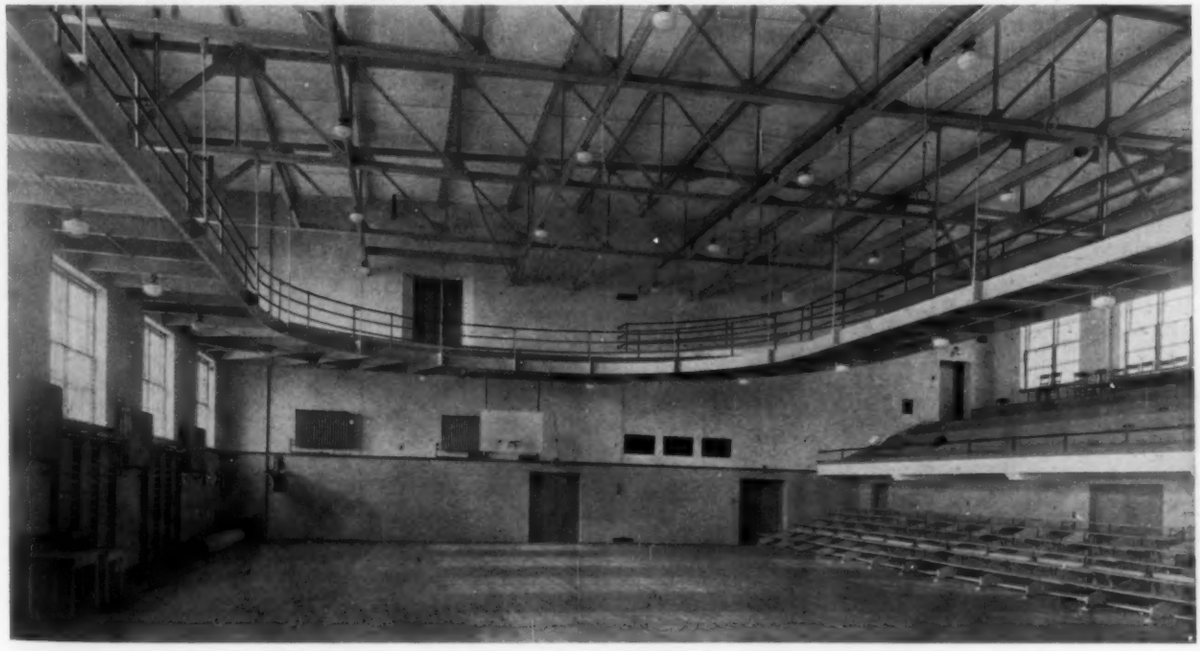
Boys' Gymnasium, High School, Mount Clemens, Mich.
Joseph C. Llewellyn Co., Architects



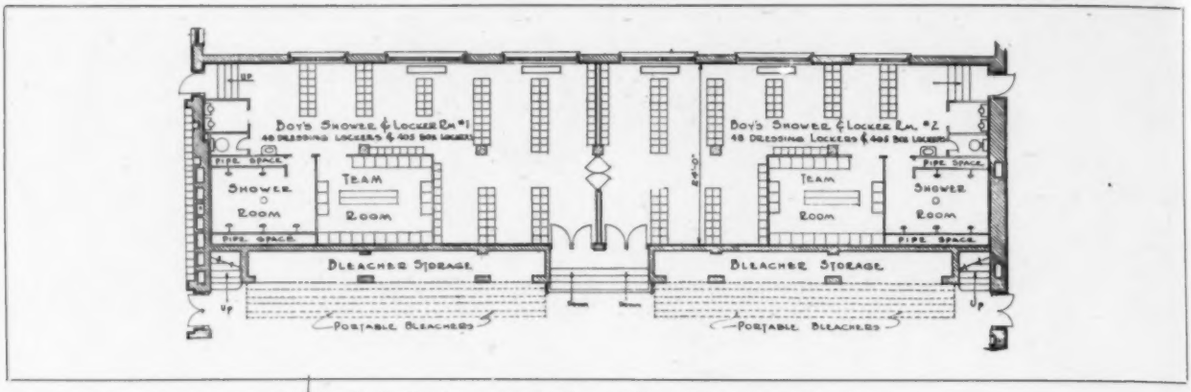
Stage, Girls' Gymnasium, Benjamin Bosse High School, Evansville, Ind.
Joseph C. Llewellyn Co., Architects

interfere with a full use of the entire floor area. For the bleachers, sight lines should be well considered. The fronts of the permanent bleachers should be as near to the floor as possible to permit of good view of practically the full playing floor, but high enough to permit of three or four rows of portable bleacher seats. Concrete construction, smooth finish, painted or chemically treated, forms a good base for seats made of 2 x 4-inch cypress or quarter-sawed yellow pine strips, shaped to proper section and secured to blocks to give required height, and well bolted to concrete.

Running tracks are less common now than formerly in the smaller gymnasiums. For large schools, the coaches want them. The construction must be able to carry the standard floor load, for while they should not be used for spectators, they often are so used, regardless of their inconvenience. The floor of the running track must be carefully planned with proper banking at all turns, and laid with narrow



Boys' Gymnasium, Lyons Township High School, La Grange, Ind.
Joseph C. Llewellyn Co., Architects



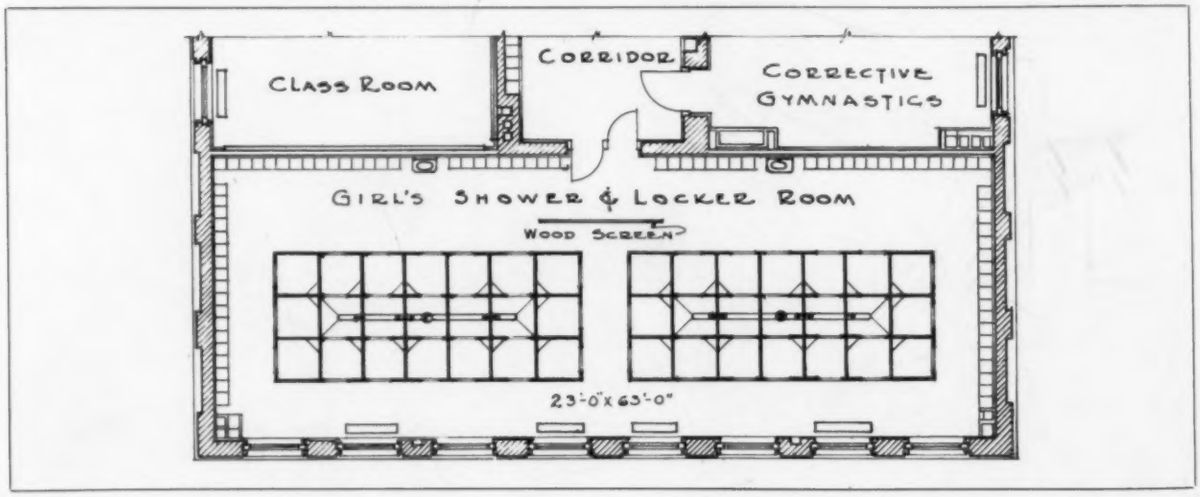
Twin Locker Rooms, Lyons Township High School
Joseph C. Llewellyn Co., Architects

flooring which will take the bending. It must be thoroughly nailed and dressed smooth, and finished with cork carpet or similar material well glued to the wood. Straightaways in schools are not common, though often desirable. However, opportunity offers at times in large schools to use a rear corridor adjoining the gymnasium as a straightaway by providing a suitable resilient floor.

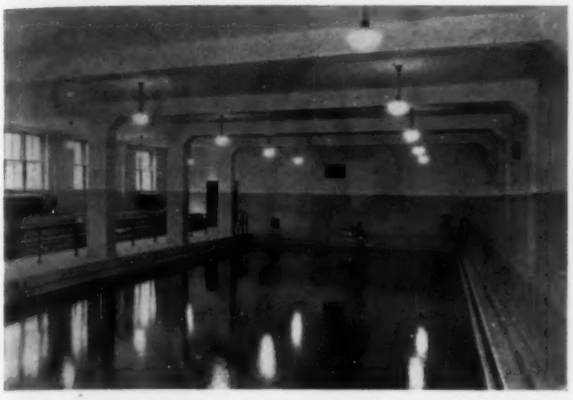
Shower and Locker Rooms. The structure of shower stalls and floors, and materials used to secure impervious divisions and walls, the treatment of walls, lighting and ventilation, all call for care and close attention. Careful planning is required to secure maximum locker facilities without crowding, to care for pupils and for home and visiting teams,—to give each the desired accommodation. For the larger schools, twin locker rooms, having shower, team and toilet rooms, make a convenient arrangement. (See page 438). In inter-school games the visitors occupy one room, the home team the other.

Various materials can be used for shower stalls. Built-up stalls of monolithic terrazzo on steel and metal cores built into the floors and ground to a smooth surface and polished, are of attractive appearance and are economical. In girls' locker rooms, dressing stalls are provided under various arrangements, varying from one dressing room to three to each shower. Some large schools, after experimenting, have adopted two dressing rooms to one shower as the best proportion, taking into consideration the time required to change classes. The size of classes determines the number of showers and dressing rooms. The average size of shower stalls is 3 feet to 3 feet, 4 inches in width and 3 feet, 6 inches in depth. A triangular locker in each girl's dressing stall permits the use of box lockers only in the locker room and is economical of space. A small mirror in each dressing room avoids crowding before general mirrors at the end of class periods.

Accessories for gymnasium and shower rooms,—such as wall drinking fountains and cuspidors in gymnasiums,—located so as not to interfere with play,—add materially to the comfort of the pupils. Mechanical means of drying hands and for hair drying are sometimes used. Their success depends on the way they are used and the care in maintenance. Ventilation of gymnasiums and locker rooms should be carefully considered. Warm air, blown into the



Girls' Shower and Locker Room, Francis Joseph Reitz High School
Joseph C. Llewellyn Co., Architects



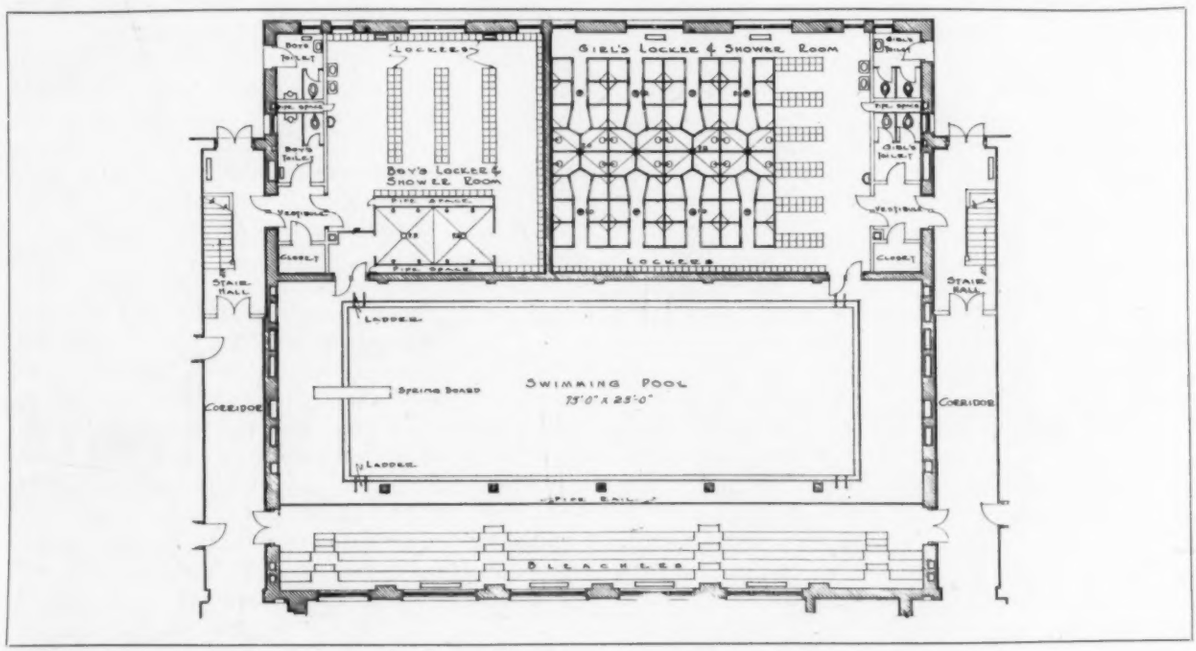
Pool, Mount Clemens High School
Joseph C. Llewellyn Co., Architects
Plan Below

Pool, Junior High School, Trenton, N. J.
Ernest Sibley and Lawrence C. Licht, Architects; J. Osborne Hunt Associated

locker rooms and mechanically exhausted, will aid in maintaining dry rooms. It is desirable to locate shower rooms so that plenty of light and sunshine can be had if possible. Without warmth and good ventilation, shower room walls and ceilings will condense moisture and produce in time more or less disintegration of wall surfaces.

Swimming Pools. Where swimming pools are used, it is desirable to plan them *en suite* with the gymnasiums so that the same locker rooms and showers can serve both and so avoid duplication. Overhead light with lifting skylights, where possible, gives considerable flexibility to the ventilation of these rooms. Insulation of roofs over pools will be a material help, and care in selection of wall and ceiling finish is necessary. The building of the pool itself is not necessarily an expensive operation. If money is limited, a substantial pool can be constructed with a concrete pan reinforced horizontally and crosswise and waterproofed with integral waterproofing. It can be lined with a bottom of white vitreous tile, sides being of white tile or terrazzo waterproofed; terrazzo gutter and rail, with markings of inlaid tile. This gives a clean, sanitary, and quite satisfactory pool. The floors of pool room can be terrazzo with a mixture to prevent slipping. The room can be finished at a reasonable cost with smooth, light gray or buff impervious brick for walls, and cement plaster, properly painted, for the ceiling. Enameled brick, tile, or terrazzo make attractive walls at a somewhat higher cost.

Water purification in addition to filtering can be by use of chlorination, ozone, or violet ray. Each has its advocates; chlorination by mechanical means furnishes a simple and economical means. Much depends on the proper sizing of supply and circula-



Plan of Swimming Pool and Locker Rooms, Mount Clemens High School
Joseph C. Llewellyn Co., Architects

Stadium, Enlow Field, Evansville, Ind.
Joseph C. Llewellyn Co., Architects

Stadium, Oak Park, Ill.
Joseph C. Llewellyn Co., Architects

tion piping. Often pipe sizes are too small, causing sluggish circulation. Filters, heaters, and piping to recirculate in eight hours at least are desirable.

In schools of from 750 to 1,000 pupils, coaches for boys are provided with one or two rooms, shower, and storeroom; and the physical directors for girls are given two or three small rooms for offices and workrooms and a rest room for the girls. In larger schools, these suites will expand somewhat to provide a room for corrective gymnastics or exercises for boys, and the rest room facilities for girls will be enlarged to meet the larger enrollment. For the larger schools, also, boys and girls will have their separate gymnasiums and in many schools separate swimming pools. The size of the school, its possible future growth, and the financial capacity of the school district are determining factors in planning the recreational facilities for schools. Provision should be made for maximum classes in the gymnasiums, in case of rapidly growing districts, by making larger floors than needed at first and providing for expansion of locker facilities as required. Provision for expansion of space for special work or rest room requirements can easily be taken care of and should always be kept in mind in planning.

In the foregoing paragraphs, the high school has been primarily in mind, but the trend of education today recognizes the value of work and play and is making use of them in elementary schools as well. The architect must incorporate in his elementary buildings the auditorium and the gymnasium with their accessories. The school building is also becoming more than a school for children and is a community asset as well, as the public uses various parts, especially the auditorium, gymnasium, swimming pool and possibly the library. The auditorium or gymnasium can be made accessible and separated from the rest of the school as occasion demands.

The Athletic Field. The chief of outdoor features is the athletic field. The laying out of an athletic field is pretty well established as to necessary size and shape of ground required for the various games. What is not always cared for as it should be is the preparation of the field to give proper drainage, treatment of soil to properly prepare it for seeding, and the foundations for track and straightaways. These require care, not in the preparation and seeding alone, but in the use of the field itself, until a turf is grown and track is brought to a proper condition. This work is in the province of a landscape architect familiar with the locality in laying out drainage and seeding, and it is the work of the gardener to properly maintain it; in the hands of careful and capable men, it can be made of moderate cost when its benefits are taken into account. To preserve the field in condition for school athletics, it should be enclosed. Enclosure can be made by use of woven wire and steel posts, or by brick or concrete walls. The type used will usually be determined by the location of the school, by cost and the ability to pay for it. The enclosure simplifies control in all interscholastic games in the open air.

Outdoor games, as well as indoor, draw crowds, provision for which brings up the matter of permanent seating for the public to take the place of portable or wooden bleachers. These *stadia* are of various forms from the built-up banks of earth, faced with steps of wood or flat building stone and concrete, to those of wholly concrete construction (open or covered) and faced with brick walls to make a shelter as well as to provide seats. The concrete construction, covered or not, permits of providing various facilities for the comfort of the public which earlier forms of seating do not, and which are essential.

In conclusion, school athletics and recreational activities constitute one large element in creating and maintaining school spirit and in building up school traditions, in teaching young men and women to do team work and, in doing team work, to concentrate attention on the thing to be done; to think and act quickly when necessary; to be one with one's fellows,—all qualities quite essential in after life. To plan for the requirements of athletics and recreation in our schools and give the buildings all flexibility possible in providing for the present and anticipating the future is, as was said in the beginning, an interesting thing to do. It cannot be done in a haphazard way but calls for all the care and attention possible.

DETAILS OF SCHOOL BUILDINGS

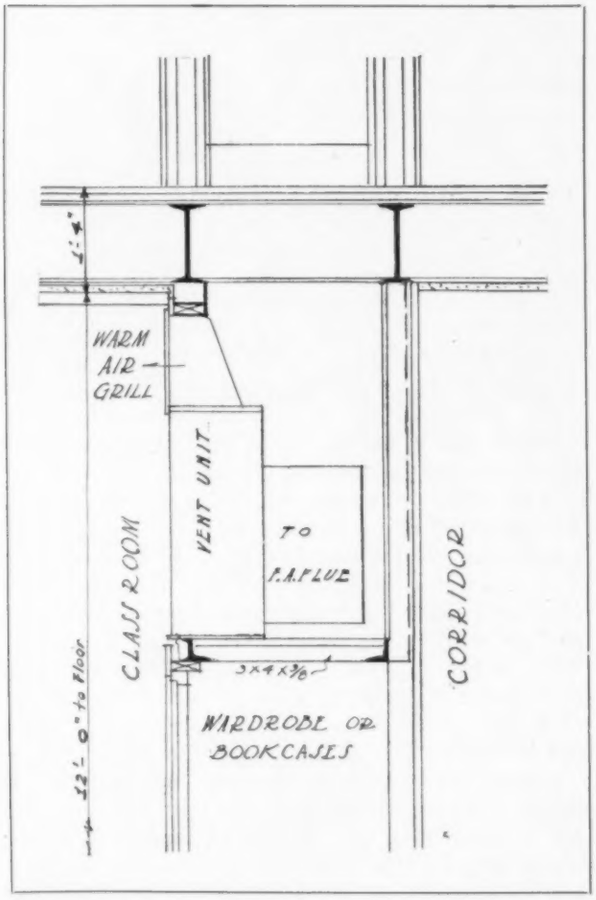
BY
WALTER H. KILHAM
OF KILHAM, HOPKINS & GREELEY, ARCHITECTS

UNDER the liberal appropriations of what the next generation may refer to as the "frenzied twenties," American schoolhouses have been developed to an astonishing degree, and while the proportion of cubic space devoted to education still remains an appropriate factor, sizes of rooms more particularly destined for athletics, amusement and times of general enthusiasm have increased by leaps and bounds, so that the planning of what might be called the "country club" type of building has come to absorb much attention from present-day architects, sometimes to the detriment of carefully thought out details. Happily the age of Romanesque monastery windows, guaranteed to exclude light from classrooms, has passed, as has the period when English hammer-beam trusses carefully constructed of plaster were considered the prime essentials for a good school auditorium; but careless or ill-considered interior details still often mar (or at least it seems so to the practiced eye) the effect of many a near-sumptuous high school. This article will consider a few of the many items which must come under the care of the schoolhouse architect and sooner or later call for prompt decision. Experience has been defined as something everyone gets when it is too late to use it; if some of these suggestions arrive in time to be helpful, the effort will not have been made in vain. As many features of schoolhouse detailing have been previously considered at length, the main discussion in this article will relate to developments in material and design which have come about since the war.

The Classroom. No matter how many accessories the modern schoolhouse may have accumulated, the classroom still remains the predominant feature, and its main attributes do not undergo many changes. The average size for 35 pupils of the sixth grade to high school remains at 22 x 30 feet, which accommodates five rows of desks across and seven rows deep, with a 3-foot wall aisle, four 18-inch interior aisles, and a blackboard aisle of 3 feet, counting the desks as 24 inches wide. The whole width then totals 22 feet, not too much for the inner part to receive a fair amount of light, but still not down to the standard of the future, which will some day reduce it to four rows or maybe 18 feet, when standard classes shall have been reduced to 28 or 30 pupils.

Windows. The standard window space remains at the empirical figure of 20 per cent of the floor area, which seems to be as much as can generally be obtained, considering the difficulties of wall and window frame construction and the heights of window radiators; and if the light is not affected by lowering shades, it is fairly satisfactory on bright days. The future may see a general adoption of some form of white "blackboard" which would materially reduce the absorption of light. The difficulties of wall construction, as far as they relate to wide window spaces, are largely overcome in steel or concrete frame construction, but the average rural or suburban schoolhouse is still far from being of that type, and depends on wall-bearing brickwork for its main supports. A certain amount of pier space along the 30-foot length of the room is therefore necessary, and the architect, while holding these piers down to the least width compatible with strength, has to see to it that they are not so wide as to cast any troublesome shadows.

The sashes themselves, which for the present may be considered as of wood, should also be kept reasonably narrow for ease in operation. If made over 4 feet, 6 inches or 5 feet wide they become unduly heavy, requiring larger weights and stronger frames, and are weak unless made with a liberal amount of woodwork. A good arrangement from the sash manufacturer's point of view is that of three pairs of double windows for each room, providing it does not interfere with the exterior architectural design. Three pairs of such windows, each about 3 feet, 6 inches x 9 feet will fulfill all the legal requirements for a room 22 x 30, and all the sashes will fall within comfortable sizes for glass, cords, weights and woodwork, and will be free from any tendency to stick. The question of "double-hung" versus tilting windows still remains open. Both types have warm friends and vigorous enemies, though the friends of the tilting type are very positive and numerous among the teachers,—who usually like the larger quantities of fresh air which they can thus secure in defiance of the heating engineer's calculations. Local ventilating units, locally controlled, by which the supply of pre-heated air can be shut off when it is desired to open the windows, are being installed in many schools. Their use obviates the long runs of warm air ducts of central systems and reduces cubage factors, which appeals to most architects, while teachers welcome the possibility of room control over the vexing matter of ventilation, a privilege which is not, however, very freely granted to them as yet. The objection to this type of ventilation is that it is dependent entirely on the ideas, whims and control of the teachers, who may or may not understand ventilating needs. As what constitutes proper ventilation is a moot question, which is considered in a separate article, we mention here only the space saving that attends the use of the local ventilating units. The whole unit apparatus is contained in a neat steel casing of unobjectionable appearance as far as its design is concerned, but it constitutes a certain obstacle if placed in the window aisle. This location is the most favorable from the point of view of economy, as no long runs of sheet



Sectional Diagram of Unit Vent Shown on Opposite Page
Kilham, Hopkins & Greeley, Architects

metal ducts are required to reach the outer air, but various efforts have been made to remove the unit from the room and to place it in a less conspicuous location. One of these sketches shows an arrangement designed by the writer for the James Russell Lowell School at Watertown, Mass., which places the unit in the space ordinarily wasted above the tops of the "Chicago" wardrobes, thus releasing the floor space and clearing the window aisles. A slight increase in cost, hardly appreciable in the total for the building, is caused by the short runs of galvanized duct between the unit and the outer walls.

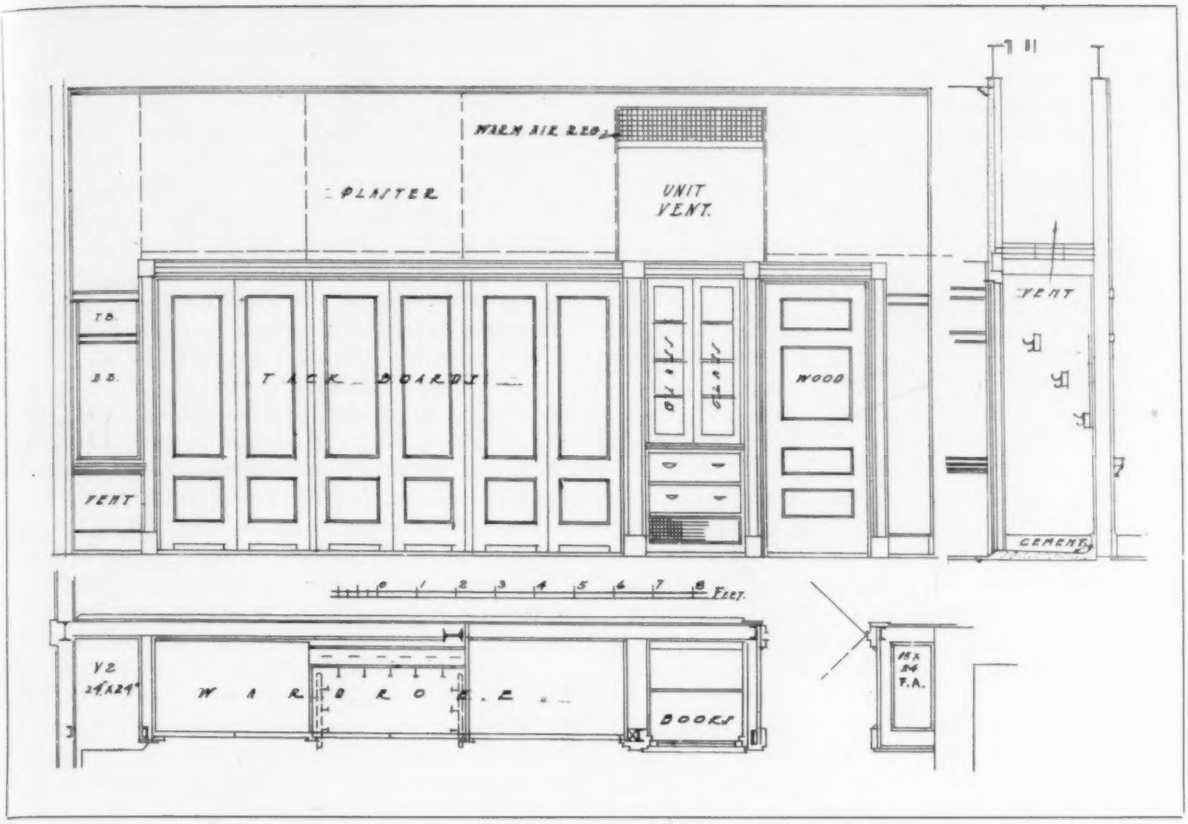
Blackboards and Tack Boards. Still another development seems to be the growing encroachment of the tack board on the time-honored blackboard space. Many teachers ask for as much as 50 per cent tack board space, going the full width of the blackboard, while others, generally those in the lower grades, want a cork carpet border about a foot wide going all around on top of the blackboard, which is reduced in height for this purpose; still others eschew the cork carpet and demand a board of soft pine or whitewood into which thumb-tacks can be easily pushed, leaving their marks, however, behind. There are ingenious devices available that provide easy means of hanging drawings and other exhibits without marring or danger of falling. Whichever fashion prevails, it is a useful practice to provide an instrument board near the door on which the switches, telephones, thermostats, etc., can be mounted,—that is, providing the electrician can be induced to forego his insatiable desire to put these contraptions in the center of the best wall space in the room.

Blackboards. Blackboards should never, of course, be placed on the window side, and as much space as possible should be saved for them along the inner wall and behind the teacher. A good general rule for heights of chalk troughs above floors is:

2′ 2″ from the floor in kindergarten.
2′ 4″ to 2′ 6″ from floor in grade IV.
2′ 8″ from floor in grades V to VIII.
2′ 8″ to 2′ 10″ from floor in high schools.

Screens for erasers above the chalk rail are not generally regarded as being standard equipment, but they are occasionally demanded. They should be of light but strong construction. The ideal, of course, would be a type supported from the back on brackets, so that the troughs could be wiped out with a continuous motion of the hand, but in practice some front supports are necessary.

Wardrobes. In grades below the senior high, the "Chicago" type of wardrobe, integral with the classroom, seems to have found great favor with school authorities on account of its convenience, and with architects on account of its saving of cubage, though probably no one would attempt to say that it is superior to the old separate coat room, especially if the latter is provided with an outside window on the sunny side of the building. Others like placing lockers or wardrobes along the corridor walls, an arrangement more suitable for high schools than the lower grades. The "Chicago" wardrobe saves cubic and square foot space, but it causes loss of a lot of blackboard space, unless it is placed at the rear end of the room opposite the teacher, which should, of course, always be done, but which is not always economical. The most difficult problem about it, after its location is settled, is that of the doors. Shall the doors be hung with weights and slide up and down, or shall they fold back into the wardrobe, or shall they pull down in roller-slat fashion? If they slide up like windows, the long frames and weight boxes are rather a disfigurement to the room, though space is certainly saved. If the doors are mounted on any of the clever folding hardware devices, each is likely to require a little of the length of the wardrobe for folding back, space which may be sorely needed for hook space in case the wardrobe shares the narrow end of the room with a bookcase, a communicating door, and the heat and vent ducts. Details included here show methods of constructing both of these types in recent buildings. The wardrobe may well have a cement floor with a coved base, raised an inch above the classroom floor at the front with a bevel and sloped back to prevent water from umbrellas or wet clothing running out on the classroom floor, and it should have a 6- or 8-inch vent connection in the top and suitable air intakes with



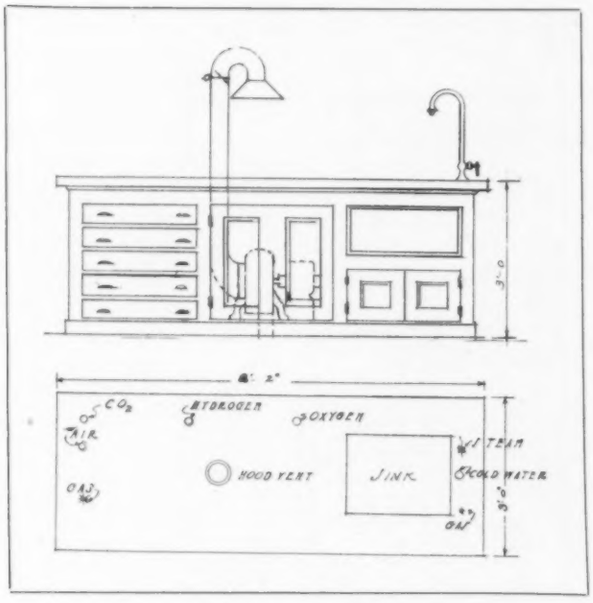
Detail of Wardrobes, Cases, Heating and Ventilating
James Russell Lowell School, Watertown, Mass.
Kilham, Hopkins & Greeley, Architects

doors at the floor, so that the draft will always be *into* the wardrobe from the room. The racks for coat and hat hooks may be either poles on metal brackets or flat 1x4-inch strips on wood or metal frames. The flat type has the advantage of never slipping and being adapted to stenciling numbers, should this be desired.

General Trim. This should be of simple design, without elaborate mouldings or sharp edges which could readily be injured. Architraves are desirable around doors, to prevent injuring the plaster, but they may be omitted at the windows if plaster jambs are substituted with corner guards, if the committee really wants to reduce upkeep costs in the future. Slate or artificial stone is a good substitute for wood window stools to prevent the deterioration of wood where exposed to water of condensation, strong sun and perhaps rain beating in if the window is open. On the whole, some architects think block trim more practical than mitered. Transoms over doors are usually unnecessary. Steel trim of course demands consideration for each project, but a form of substantially enameled base is wanted, as paint quickly disappears from the ordinary steel base when the floor is subjected to mopping. Bookcases are essential, but their type has undergone little change.

Stairs and Corridors. Here again the advent of battleship linoleum, cork and plastic floors has changed the scene and effected an enormous reduction in the amount of noise. The use of fabric flooring has done away with the old terrazzo cracks which always appeared to greet the critical visitor right inside the main entrance. The corridor dado needs to have eminently wear-resisting qualities, and can be made of tiling or salt-glazed brick in the more "Ritzy" type of buildings, or of plaster covered with cloth in plainer structures; but only a confirmed optimist will build them of that material hopefully termed "hard plaster" without protective covering.

A considerable variety of materials is now offered for stair treads. Steel pans filled with cement, asphalt, terrazzo, non-slip abrasive tiles, linoleum and many other products are available, as well as blue stone, slate, etc. A steel non-slip nosing is a guarantee against undue wear. Some schools have had wooden treads thus fortified go through over 25 years of hard usage without perceptible damage. Different states have various rules for the height of the balustrade, but in any case a handrail at the usual height on *both* sides of the run is essential. Some states even require a 5-foot balustrade. Careful checking up of local regulations in this respect is necessary. The balustrade, if of iron, should be of simple type, and consist mainly of vertical mem-



Demonstration Table
Alexander Hamilton Junior High School, Elizabeth, N. J.
Kilham, Hopkins & Greeley, Architects

bers for easy cleaning. In some cities solid balustrades are preferred to prevent objects' dropping through. The nature and characteristics of the stair well or tower also need thorough study. So many fires have gained headway by shooting up the stair wells that it seems that enclosing the platforms at each floor with self-closing fireproof doors should be universal practice, even though it is not always obligatory. These doors and the partitions which contain them are generally made of kalameined wood, which is neat in appearance and sufficiently fire-resisting. The panels and transoms are filled with wired glass to transmit light from the outer windows, that in the door being clear wire-glass. The "smoke doors" so called, should open *toward* the stairs and should preferably consist of one pair without a central bar, so as to direct the stream of pupils toward the downward flight. The hardware should consist only of self-closing door checks, butts, pulls, and push and kick plates. Floor stops, hooks, or other attachments for holding doors open should be omitted, in spite of the tearful protests often received from the teachers, for such accessories defeat the primary object of the doors, which is to provide constant protection against smoke or flame in the stair wells by closing off any up-draft of air. Massachusetts and some other states require that the outer corners of the well be rounded on a 2-foot radius or cut off with a diagonal corner of equal size, to prevent wedging of small pupils in the corners in case of panic; and all landing radiators should be either recessed in the walls or hung on the walls above head height. Where gas is available, emergency gas lights are also desirable; and the electric lights for stairs should be carried on separate circuits controlled from the principal's office as well as locally.

Even in buildings of second class construction the stair wells should be absolutely fireproof, and the best wall material, in the opinion of some architects, is glazed or salt-glazed brick, which is durable, cleanly and does not require painting. The stairs when practicable should be located at the ends of corridors, so that light from the stair windows will shine through the smoke partitions and along the corridors. Stair towers should not be more than 125 feet apart. Some states allow, and others forbid, by-passes through schoolrooms with communicating doors, so the architect has little option in this respect, and he can best serve the community by insisting on plenty of stairways, easily accessible. The riser and tread sizes are also subject to public regulation and should be kept at a comfortable proportion, for obvious reasons. Closets should never be constructed beneath stairways, under any conditions.

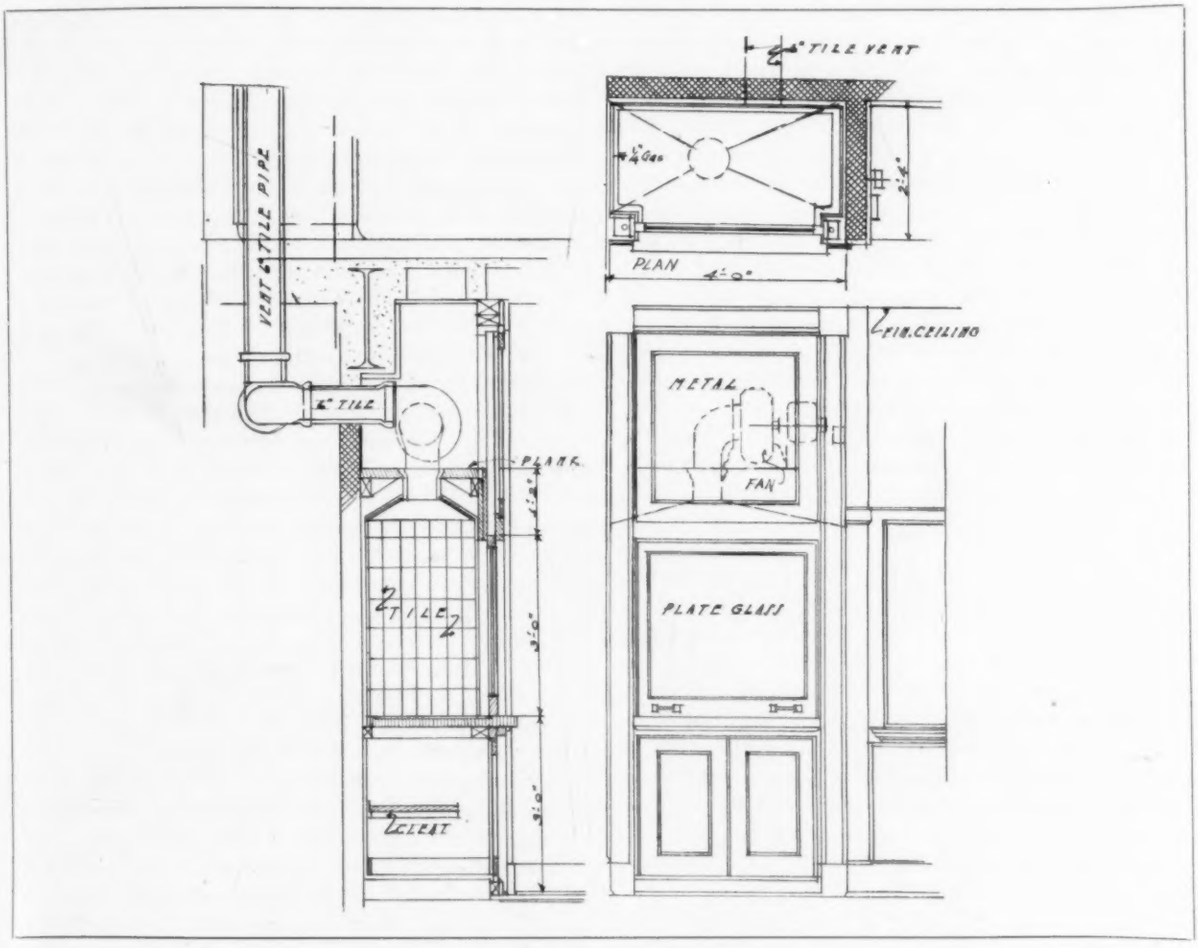
Toilets. The science of sanitation in this respect is well advanced; in fact, in the opinion of many foreign writers the character of American civilization is expressed in our plumbing, and the matter of designing toilet rooms for its accommodation is not less well developed. The architect will, however, have to decide upon the materials with which the floors, walls, and partitions are to be constructed. It should be said that the essential requirements are first, light, which shows up dirt; and second, ease of cleaning. To this end a light colored floor is most desirable, even though it keeps the janitor busy mopping up, for a black floor absorbs light, conceals dirt and is always unattractive. White vitreous tile or mosaic, perhaps with black dots or pattern, and white glazed tile dadoes are none too good for the purpose. For toilet partitions, marble or some of the white products are ideal, but costly. Slate has the disadvantage of absorbing light and being easily marked. Enameled steel is in quite general use, but wood doors are sometimes preferable to steel doors, as they are less noisy and easier to adjust when a measurement goes wrong.

A technical discussion of various types of plumbing fixtures would occupy more space than is afforded by the limits of this article and is more adequately treated elsewhere in this issue of THE FORUM. In passing, one might question the use of expensive individual vitreous china basins for hand washing, when a good white enameled sink provided with plenty of faucets where the hands may be washed under running water might serve the purpose far better and actually be in closer accord with modern ideas of cleanliness. The single basin, seldom cleaned, with self-closing cocks which limit the supply of water, while pleasing in appearance, is often more of an obstacle than a help to personal cleanliness. Some sort of screens, or deflected passages to toilet rooms from corridors are thought necessary by educators.

Museum Cases. A good many schools gradually acquire specimens of minerals and all sorts of natural history or other exhibits, not to mention athletic

cups and trophies, for which no suitable place is provided. It is often easy to provide cases which can be snuggled into spaces around the heat and vent ducts, with glazed doors opening on the corridors where such objects can be properly displayed. Most cases should be white inside, and if the matter is of sufficient interest, may even be provided with lights.

The Kindergarten. The consensus of opinion requires that this room shall have a full southern exposure so as to obtain all the beneficial effect of floods of sunlight. This is mentioned somewhat guardedly, as the writer was recently a dissenting member of a jury of A. I. A. architects which awarded a competition to a plan which placed the kindergarten on the north side, mainly on account of an artistically drawn lilac bush placed in front of it by the skillful renderer. The program forbade any accessories! Having been then over-ruled on this point by prominent members of the profession, he is still a little timid about it, but continues to cherish the notion that the south side is best. The kindergarten should have its own separate entrance and, if possible, a level and sunny playground, even with the door sill, so that the juniors will not have to be helped up and down steps when they go out to take the air. Their coat room should be of a size which will allow a bench for the attendant to use when putting on their rubbers and arctics and buttoning them into their what-alls. The toilet, which should be of an extreme handiness to the main room, will need special low-height fixtures and plenty of light. As considerable time will be spent by the pupils on the floor, that detail of a kindergarten requires special consideration. The ideal material would be something warm, or at least not too much of a heat conductor, which is at the same time easily cleaned,—cork, either tile or carpet, or one of the new rubber fabric floors seems to fill the bill as well as anything. Some regard cork carpet as not being susceptible of easy cleaning, but it has been successfully used in a good many kindergartens and is warmer than linoleum. The fittings of a kindergarten will vary according to individual wishes, but will generally include boxes and compartments for blocks and playthings, a large amount of tackboard space, and probably a small amount of blackboard.



Hood in Science Room

Alexander Hamilton Junior High School, Elizabeth, N. J.

Kilham, Hopkins & Greeley, Architects

The larger and smaller rooms which usually constitute the kindergarten suite are sometimes separated by rolling or accordion doors, to allow them to be easily thrown together. Custom seems to decree that the kindergarten should have a fireplace, but committees seldom appropriate money to buy wood, so its bricks often retain their virgin cleanliness for generations, unmellowed by smoke. However, an inglenook with seats looks well, and sometimes there is a gift of firewood, so that a fire is actually started. For this reason it is always well for the architect to see that a practical flue is constructed, which does not end in an air duct! Bay windows and other attractive features are appropriate for this part of the building and are sure to be appreciated.

The Auditorium. It must be said that the type of school auditoriums seems to be passing through a transitional stage. For large schools of 1,000 to 2,000 pupils the effort has heretofore been directed toward providing an auditorium capable of seating the entire membership at once. The expense of building such rooms as these, as well as their somewhat unwieldy sizes, has led to the consideration of the suitability of smaller types. If, for example, a two-platoon school of 1,500 were equipped with an auditorium for 750, the costly overhanging balcony could be omitted and the entire number comfortably seated on a rising floor with every occupant in full view of the others and not hidden by balconies. For the construction of such a room the general specifications for a theater minus the expensive decorative effects, could well be followed. Every effort should be made to assure good acoustics. Fortunately, several commercial systems of treatment for the walls and ceilings are available, and they can be trusted to produce reasonably good results. Upholstered seats will help, and linoleum or fabric for the aisles, if not for the entire floor, is desirable to minimize the noise made by persons entering and leaving. A form of wainscoting, for which purpose there is really nothing much better than wood, is necessary to protect the walls from hard usage, and no projecting radiators should be tolerated. An auditorium, however, differs from a theater in that it usually has windows for day lighting, and means must be provided for excluding light when it is desired to give picture exhibitions. This may be accomplished by means of opaque rolling shades, running in grooves at the sides of the windows, or by heavy draw curtains, which are simpler and perhaps fully as good, as well as being more decorative. The windows themselves will require some thought, as the sashes should not be too large and heavy, and provision must be made for cleaning them.

Some schools wish completely equipped theatrical stages, with switchboards, fly galleries, smoke ventilators and even grids. Such halls will probably also want sunken musicians' pits and complete dressing room layouts. It is difficult to know just where to draw the line in these cases. Good school shows can be put on with very modest equipment, and if modern ideas of stage lighting effects are followed, the expensive borders and drops can be omitted. In any case, the architect must remember that his stage problem is four-fold, for he must provide facilities for (a) a single speaker with perhaps a few persons in chairs to form an *entourage;* (b) provision for a class of maybe 100 or 200 for graduations, or producing cantatas; (c) accommodation for a dramatic production, either by the students or by a regular troupe, professional or amateur; and (d) facilities for showing motion pictures. To fulfill all these requirements and satisfy everyone will require ingenuity and some tact. A "cyclorama" of velours provides a good background for the single speaker and closes off the somewhat dreary look of an empty back stage. The back of the proscenium must be arranged for the fire curtain, draw curtain, sprinkler pipes, picture screen and lighting effects. The switchboard should be sunk or raised so as not to interfere with the operation of the play, and all the local regulations will have to be carefully studied; and adequate special exits must be provided for the stage. Other special features of the auditorium are the motion picture booth and its ventilating system; the manner of lighting, which must not interfere with the projection machine; the type of entrance doors,—whether with or without transparent glass; and the type of ceiling. If the auditorium is contained in the center of the building, outside light is often admitted from the roof, which involves much care of the glass ceiling. This arrangement, however, seems to be passing out in favor of the exterior auditorium with side windows.

Aside from these observations regarding various special items of schoolhouse construction, there are certain basic requirements which ought to be kept in mind in drawing up the details. Among these are durability; ease of maintenance; economy in first cost, (which would include transportation and time required for obtaining the product); suitability for attractiveness of appearance. Mouldings with sharp edges or wide flat surfaces which collect dust are easily damaged and unsuitable, and yet one often sees clothes racks or stair newels carrying the full Doric order as decoration. Wall tiling has its place in toilets and corridors, but one of the most costly and highly praised of the recent high schools has the boiler room finished in white glazed tile and the main corridor in cheap textured plaster! Many chapters might be written about exterior detailing. Some optimistic members of the profession believe that painting the back of a parapet wall with some evil-smelling compound is a perfectly good substitute for 16-ounce copper, and they wonder why their million dollar roof leaks after a couple of years. Others are completely in the dark about the mysterious efflorescence which appears under their window sills, or the strange disintegration of elaborate pinnacles and ornaments. To all concerned in schoolhouse building, the question of detailing is a fascinating and profitable subject, which will repay study.

SCHOOLHOUSE MAINTENANCE AND MATERIALS

BY

GEORGE F. WOMRATH

ASSISTANT SUPERINTENDENT IN CHARGE OF BUSINESS AFFAIRS, MINNEAPOLIS PUBLIC SCHOOLS

TWO billion, three hundred forty-four million, nine hundred eighty-four thousand dollars! This represents the contract expenditure for school building construction and equipment in 36 states for the past seven years only. As the greater part of this construction work has been financed either by long term or short term serial bonds, it is fair to estimate that the actual cost to the tax-paying public for these schoolhouses by the time the bonds are retired will be 50 per cent more than the principal sum, or a grand total of $3,517,476,000. For the entire United States the gross investment in school building construction for the seven years, for which the foregoing figures were compiled, was a sum considerably more than $3,500,000,000, practically all of which must be paid by taxation.

With the completion of a school building, its cost to the public does not cease; there at once begins the cost of operation and maintenance. This latter cost becomes an index of the wisdom shown by those responsible for the original construction investment. The figures involved are so large that even a small percentage of saving becomes an impressive amount. It behooves those accountable for the handling of public school funds to carefully consider every item entering into the construction and equipment of a school building and to weigh its original cost against its subsequent cost of maintenance. It has been repeatedly demonstrated that, by carefully revising the plans and specifications of school buildings upon which bids have exceeded appropriations, a saving of from 5 to 10 per cent can be made. School board members, superintendents and school architects are called upon as never before to study the problems of schoolhouse construction, in order that the tax dollar may provide the best buildings possible, and that these buildings may be so constructed and equipped that subsequent maintenance costs will be a minimum.

Not many years ago, when a school building was wanted, the common practice was for the school board, or the superintendent, or the school building committee to select an architect and tell him to prepare plans for a school building of a stated number of rooms or to accommodate a certain number of pupils. In many instances the architect selected was totally unfamiliar with schoolhouse design. During this period, questions of economy and efficiency in schoolhouse design, construction and equipment received but slight study; as for standards for heating, ventilation, lighting and sanitation,—there were none.

Of recent years specialists in schoolhouse architecture, with their engineers, have made exhaustive and extremely valuable studies of the school housing problems in many cities, involving many types of school administration and widely divergent curricula. Surveys were made to establish relationships between educational activities and requisite floor space needed. The ultimate outcome of these surveys was use of the "candle of efficiency" in the report of the Committee of Standardization of Schoolhouse Planning and Construction of the National Education Association. Mechanical and physical data were worked out and made the bases for state and city laws, ordinances and regulations governing schoolhouse construction and mechanical equipment. These men carried their ideas from one part of the United States to another. During this period, architects and engineers practically determined all school building policy insofar as design, planning, construction and equipment were concerned, the superintendents confining their activities to instructional policy only. The pendulum had swung to the extreme of the arc. Schoolhouses were built almost without any consideration being given the superintendent; in many instances without regard to cost, elaborateness, or sizes and number of rooms. Time and time again a schoolhouse was handed over to the superintendent with the admonition to "go ahead and run it,"—a building in which he had had no part whatever in planning, designing or equipping.

Whether it was the high cost of the school buildings which were designed and constructed during this period of development or a recognition on the part of the superintendents of their waning control,—whatever the cause, by the year 1915 the pendulum began to swing back. Both educators and laymen began to recognize that the superintendent of a school system holds a dual position, which in industry is more often designated by the title of "general manager." He is not only responsible for the instructional phases of education, but also for the physical surroundings in which the youth of the nation are being educated. He is charged with the task of preparing the building and financial programs, and of appearing before the boards through which the money to carry out the programs must be secured, and of getting from them the needed appropriations. It gradually became fixed in consciousness that the principle of direct responsibility should be applied to school business as it is to industry, namely, that the person responsible for the quality of the product and its cost should also be made responsible for the complete organization and machinery by which the quality and cost of the product are determined.

As the superintendent began to be recognized in his dual role, we find the architect and superintendent discussing and selecting designs and elevations as to architectural beauty, grace and dignity; working out the problems of space allocation and economical floor planning for the kind, size and relationship of rooms needed and their utilitarian arrange-

ment; examining construction features and studying and comparing original costs and subsequent maintenance charges; judging building materials with respect to their practicality and lasting qualities, and selecting efficient mechanical and educational equipment on the basis of low original cost commensurate with economical operating expense and cost of maintenance.

"Cost" has become an important word in the modern school world. It represents a factor entering into every phase of modern school administration. Simply stating the cost of building construction, no matter upon what basis,—whether cubic foot, square foot, classroom, pupil, or any other,—does not reveal where a lack of economy may exist in design and equipment, either as to original cost or subsequent maintenance. A detailed analysis of all costs,—a picking to pieces of all of the factors of cost that enter into the design, plans, construction, equipment, construction superintendence, and architectural and engineering fees,—often reveals places where economies may be made to very favorably affect construction and maintenance costs without lowering in any way the ultimate educational, architectural and mechanical value of the building. What, then, are some of the items through which savings may be effected?

Types of Construction. The only three types of construction which have been countenanced in recent years for schoolhouses are defined in the Classification Code of the American Institute of Architects as:

"Type A. A building constructed entirely of fire-resistive materials, including its roof, windows, doors, floors and finish.

"Type B. A building of fire-resistive construction in its walls, floors, stairways and ceilings, but with wood finish, wood or composition floor surfaces, and wood roof construction over fire-resistive ceilings.

"Type C. A building with masonry walls, fire-resistive corridors and stairways, but with ordinary construction otherwise, i.e., combustible floors, partitions, roofs and finish."

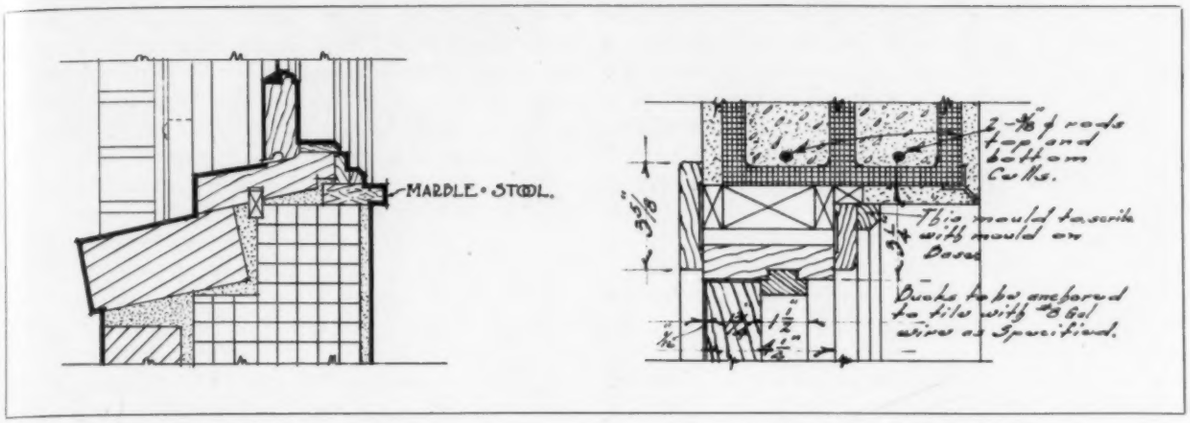
Type A construction seems impractical for a school building. To provide fire-resistive materials for classroom floors and built-in furniture and equipment would involve not only a high cost, but would be prejudicial to the comfort and well-being of the pupils. A schoolhouse must be made safe for the youth housed therein. For this reason, Type C construction, often referred to as "slow-burning mill construction," is not as desirable as Type B construction. Furthermore, as it has been repeatedly proved that the difference between the cost of a Type B and a Type C building is often as low as 5 per cent and seldom above 10 per cent, it is extremely unwise to attempt a saving in this direction if for no other reason than to safeguard child life. The factors of insurance rates and maintenance charges are financial considerations which militate against any type of construction below that of Type B. Not infrequently the temptation presents itself to build all one-story parts of school buildings of non-fire-resistive material. This is highly inadvisable, as the burning of these parts of otherwise fire-resistive buildings has not only caused large financial losses and the closing of buildings while repairs were being made but has caused stampedes which have resulted in large losses of life.

Materials and Details

Face Brick. In addition to making a comparison of the appearance and prices of brick which are to be used on the outside of the building, special consideration should be given to their size, durability and weather-resistive qualities. The selection of a small brick will involve use of many thousands of additional wall brick and a much greater labor cost in laying them; the increased number of joints will multiply the chances for maintenance trouble; while the gross cost of the brick and labor is often much more than that of a larger size of brick at at higher cost per thousand. Soft, underburned brick with poor wearing qualities, laminated brick, and glazed brick with surfaces that may easily be chipped, should not be used, if subsequent maintenance expense is to be avoided. In addition to natural wear and tear, the defacement of these bricks by school children is to be considered.

Parapets. There are certain kinds of parapets which should be omitted from a schoolhouse regardless of their artistic beauty, simply because they are costly to maintain, especially in cold climates where frost and freezing occur. Parapets which are irregular in shape, highly ornamented, or with port holes are especially subject to rapid deterioration. The cost, utility and durability of the materials used as the covering for parapets should be carefully compared. The principal consideration is securing a covering which will not disintegrate under the action of either time or the elements. The method of application of the material is also of vital importance. A material of strength and durability, if applied with exposed joints and meeting strips so that the weather can penetrate them, is soon forced out of position and rain water is admitted. When this happens the coping is loosened and is likely to fall; the wall beneath the coping disintegrates; and water leaks into the building, causing ruin of plaster, woodwork and paint. It is a costly operation to repair roof parapets and chimney tops, so a careful consideration of the material used to protect them and its application is important. Copings of tin and galvanized iron are not durable. Bronze and copper copings are not sufficiently serviceable to warrant their high cost. Plain stone copings or copings of glazed salt tile of a selected quality will endure, if the joints are made properly, as long as the building itself, and they are moderate in cost.

Roofs. A flat roof is less expensive in original cost than almost any other type of roof construction,


MARBLE • STOOL.
2-#6 J rods top and bottom Coils.
This mould to scribe with mould on Door
Ducts to be anchored to tile with #8 Gal wire as Specified.

Typical Window Detail — Typical Door Jamb and Trim

Bureau of Buildings of Board of Education, Architects, Minneapolis

is cheaper to maintain, is more easily accessible, and is safe for the public. Sloping roofs covered with slate are deserving of special consideration. Unless the slate is applied with extreme care, and the roof provided with guards, the slate often becomes detached in windy weather and slides off, as does also the accumulation of snow, endangering the lives of persons who may be below. Tile roofs are difficult to lay so that they will be perfectly weather-tight and are difficult to insulate. Maintenance costs are not as much of a problem in their case as is the heating cost of the building.

Chimneys. In these days when chimneys on school buildings are no longer looked upon by architects as disfigurements, these shafts have become the objects of special architectural study. When confined to simple and dignified lines they can be made beautiful and attractive. Costly patterns built into chimneys are often obliterated by soot and dirt, especially if these designs are near the tops of the chimneys. A poorly constructed chimney is a perpetual cause of maintenance expenditures; a badly designed chimney results in high heating costs and often develops into a smoke nuisance. The inside of the chimney should be perfectly straight, or preferably somewhat smaller at the top than at the bottom. This is for the reason that as the gases ascend they cool and contract and require less area for discharge at the top of the chimney than they require at the bottom when leaving the breeching. If the stack is larger at the top than at the bottom, the draft is destroyed by the air rushing down the stack and establishing cross currents. This will also result in the chimney smoking badly.

Windows. Schoolhouse windows have been for years and still are the matter of much debate. Wood versus steel sash; double-hung versus swivel sash; casements versus French windows;—around use of these various types there goes on a seemingly never-ending dispute. It is claimed that use of steel sash increases the operating expense of a building because steel conducts heat out of the structure so rapidly that the burning of a considerable larger amount of coal is required to properly heat the building. The original cost of installing window shades on steel window sash and their subsequent maintenance cost have also provoked much discussion. The experience of the writer has been that wood sash are preferable in northern climates.

Window Sills and Stools. It is false economy both in original investment and subsequent maintenance cost to build window sills and stools of any other than the very best materials. The drying, rotting, paint-removing, and wetting effects of the sun, rain water, and drippings from flower pots which are so often used in school buildings, have repeatedly demonstrated that sills and stools should be built of a durable material such as stone, brick or marble.

Entrance Doors. Heavy, metal-covered entrance doors were formerly looked upon as safety devices, in some mysterious way linked up with safety in case of fire. They were also looked upon as a means for protection from thieves, but are no longer considered in this light. Thieves enter through windows and by other easier means of ingress. Double-hung, light weight, glass paneled doors are being looked upon with more and more favor in schoolhouse construction from the standpoints of appearance, ease of operation, economy in first cost, low cost of maintenance, and light for the space just inside the entrance. Instead of using double doors in a full width of opening without a mullion, the practice is becoming quite general of having two single doors with a small mullion between them. This type of construction reduces weight, minimizes shrinking and swelling, simplifies the application of panic bolts, makes possible the installation of weatherproof doors, and makes possible the use of compact, light weight, standardized door units at low maintenance costs at all entrance openings.

Door Hooks. Only too often means of holding entrance doors open are omitted, resulting in some would-be mechanic's applying hooks or cleats which mar and cut the woodwork and not infrequently gouge deep grooves in valuable stonework. All such appliances should be avoided, and preference be

given to one of the many kinds of automatic door catches which protect both door and woodwork and involve practically no maintenance charge whatever.

Outside Door Sills. Door sills which are made of a soft material, such as wood or slate, soon become cupped and present a very dangerous hazard for the school children who must cross them several times daily. Ordinary iron sills are slippery and, therefore, hazardous. Sills which become cupped need to be frequently replaced, since they admit large amounts of cold air in winter weather under the doors. Granite sills are durable, safe, and afford an unquestioned economy in maintenance. There are various durable non-slip sills which are satisfactory.

Window Glass. Plate glass for general use in a school building is an extravagance when compared with the use of the high grade, single-strength, selected glass of modern manufacture. The lower cost of the latter is noteworthy, as glass breakage is a considerable item of maintenance expense in all school buildings. It has been said that New York spends $90,000 every year for glass replacement, and Chicago $75,000.

Flooring. No other feature of schoolhouse construction has been given more consideration than the material which should be used for schoolhouse floors. Wood, cement, tile, asphalt, rubber, stone, linoleum, mastic, terrazzo, cork, and many other materials have been used more or less successfully. In this problem of selection, the matter of appearance is often the deciding factor, whereas durability, ease of cleaning, and maintenance cost should be the main considerations. If pupils' desks are changed frequently, will the floors be damaged by reason of the many screw holes? Will the floors be soft and sticky? Will the floors be cold, hard and noisy? Will the floors hurt the feet of the children? Will the hardness of the floors cause breakage of tools which may be dropped on them? Will the softness of the floors cause them to be damaged if pianos and heavy furniture are moved across them, or will heavy equipment sink into the floors, leaving them full of bumps and holes? These are some of the questions to be answered when selecting a schoolhouse floor. Not infrequently the faulty installation of an otherwise excellent floor material builds up subsequent maintenance costs as much as does the selection of an inappropriate kind of flooring.

Inside Trim, Toilet and Shower Stalls. In a school building filled with irresponsible youth, the use of materials which will withstand the onslaughts of jackknife and pencil artists is a phase of the construction problem which is frequently overlooked. A child likes to lean against the walls, or to stand with one leg crooked with foot against the dado. For these reasons, corridor dadoes should be of hard surfaced brick, or tiling, or some other hard material which can easily be washed. Shower and toilet stall partitions should be of rugged construction and of a material that cannot be readily cut, scratched or marked. In toilet and shower rooms, and wherever there is any moisture, the use of wood should be avoided as it is unsanitary and costly to maintain. Enameled cement or steel partitions are good looking, sanitary, durable, less likely to be marked and cut by pupils, easily repaired, and their use is attended with low maintenance cost.

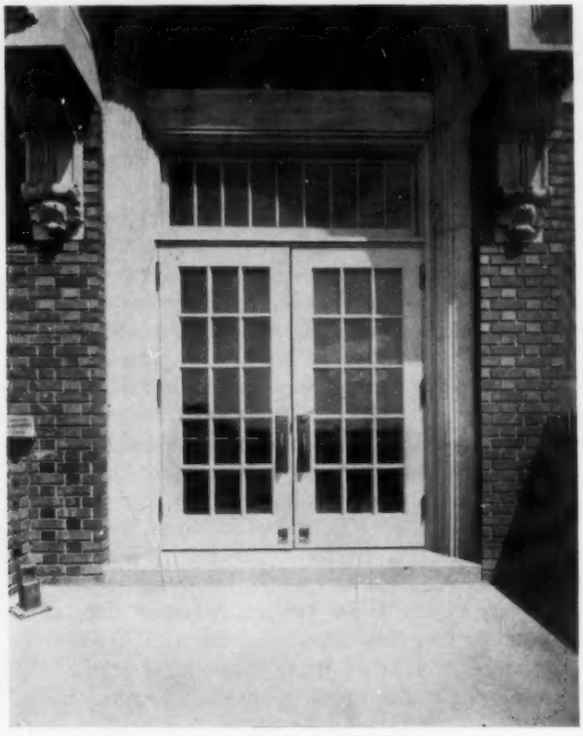
Wood and other materials of an absorbent nature should not be used in any room where there is a great amount of moisture or where immaculate cleanliness is demanded and frequent scouring necessary to prevent insanitation. The original low cost of wood construction in all such locations is offset many times by subsequent cost of upkeep.

Specially Fabricated Steel. The widening of a classroom by a few inches sometimes requires that the beams be enlarged or that especially designed beams of specially fabricated steel reinforcing be used. This at once adds considerably to the cost of construction. The superintendent should not interfere with purely architectural structural matters, such as foundations, walls, floor slabs, girders, beams, spans and other physical details. There have been many instances, however, where a general inquiry by the superintendent or architect has revealed that, without interfering with the educational efficiency of the building in any way, the reduction by a few inches of the width of classrooms has made possible a complete change in the structural framing detail of the building at a great saving in cost of construction and maintenance. The use of standard stock materials and forms results in large economies. The only places where the use of expensive, specially fabricated steel is excusable are under balconies in auditoriums, in order to avoid use of columns which would reduce the seating capacity and impair the visibility of the stage, in special study rooms, and in gymnasiums when classrooms are to be built over them.

Heights of Ceilings. The standard height of a school classroom is 12 feet, measured from floor to finished ceiling. The finishing of the ceiling generally comprises metal lath on the under side of the ceiling beams and the finished plaster applied to this lath. The thickness of this construction, from the under side of the finished plaster ceiling to the top of the ceiling beam is, on the average, about 1 foot. In schoolhouses recently constructed, a little more attention has been given to the formwork in order to produce a more even finish to the concrete after the forms are removed. The concrete is then treated with a light application of cement wash which gives the entire surface a smooth finish. The metal lath and plaster are omitted. The concrete beams are left exposed and present a very pleasing appearance. This construction is very much less expensive and reduces maintenance cost to practically nothing. It possesses the additional advantage of reducing the floor-to-floor height by 1 foot. In the average 18-room elementary school building this represents a saving of about 17,920 cubic feet per floor. Exposed beams improve acoustical properties.

Wall Finish. The wall finish in schoolhouses is,

Heavy Solid Doors



Lighter Glazed Doors

Lighter Doors Are Growing in Favor for Several Reasons

generally, either smooth or rough plaster. Many years of experience with both kinds of finish and of observation in hundreds of schoolhouses, leads to the opinion that smooth plaster is much more easily marked and damaged than is rough-finish plaster, the original cost is higher, and the making of repairs is more difficult and costly. In industrial rooms the environment should approximate, as nearly as possible, the conditions which prevail in industry. It is not objectionable, therefore, to leave the tile walls unplastered, but painted. There is no need of plaster on the walls of these rooms, and its absence adds to their industrial "atmosphere" and reduces the cost of construction and maintenance.

Corridor Walls. Corridor walls are usually built flush on both the classroom and corridor sides of all supporting columns, and frequently with an additional breathing wall on the corridor side. This is done in most instances for two reasons—to avoid the exposure of supporting columns and to hide the ventilation ducts carried up through the building. Wherever experiments have been made in the elimination of all unnecessary filler tile, there has been a great gain in corridor space, part of which has then been used for built-in lockers and cupboards. Exposed columns in public school corridors are no longer considered objectionable. Where unit classroom ventilation is used, all vertical duct work and breathing walls are eliminated. This saves from 12 inches to 18 inches of corridor space, resulting in a very noticeable reduction in construction cost.

Lintels and Door Anchors. One of the most aggravating and persistent sources of schoolhouse maintenance cost is due to badly constructed door lintels and poorly anchored door frames. Every door lintel should be reinforced to prevent it from cracking or sagging. When a door frame is not securely anchored into the supporting walls, the constant jarring due to the opening and closing of the door soon breaks the plaster surrounding the frame. When this happens the only thing to do is to reset the entire frame, or there will be a continual maintenance charge.

Wardrobes. Schoolhouse wardrobes or coat closets present a problem which causes much discussion among architects. It is safe to say that there can be no quarrel with the statement that exposed wardrobes are objectionable. Of other types there are three which are being quite generally used,—the wardrobe which is a separate room at the end of the classroom; the wardrobe which is built into either the end or the corridor wall of the classroom and which may be shut off from the classroom by pivoted or sliding doors; and individual lockers. If an opinion may be ventured, it would be that lockers have not been found to be satisfactory or practical in elementary grade school buildings. Small children cannot reach the hooks in the upper tier of lockers, with the result that their wraps are jammed into the bottoms of the lockers along with overshoes and other articles. In wet weather this condition is highly objectionable and unsanitary. The locker doors are frequently left open, and no little damage is constantly inflicted upon the hinges, locks and

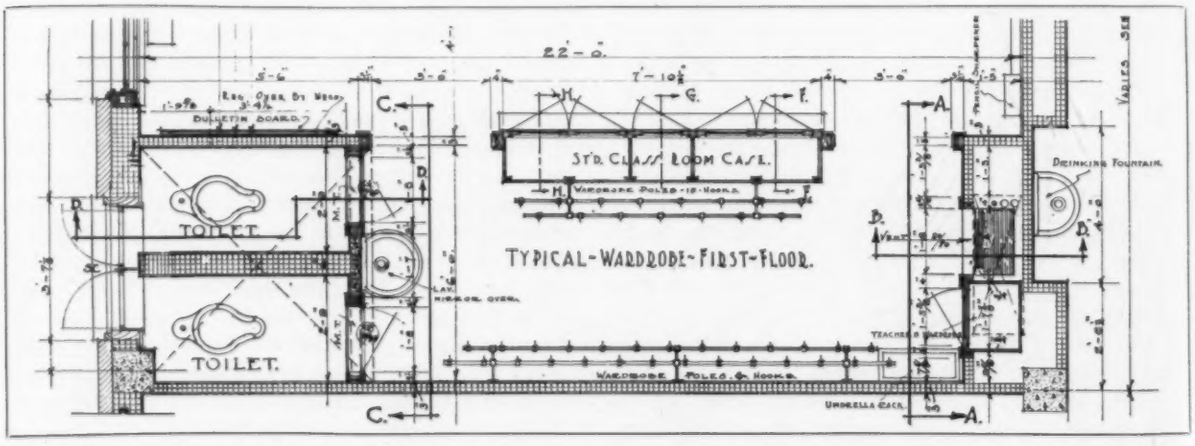
handles, which quickly runs up a considerable maintenance charge. Built-in wardrobes occupy wall space which may be used to better advantage by continuous blackboard surfaces. This type of wardrobe, when built into the corridor wall, also either reduces the width of the classroom or increases the width of the building, thus increasing construction cost,—and as in most instances where there are a large number of moving parts of some weight, the cost of maintenance is considerable.

Modern education is requiring more and more storage space in every classroom for materials and supplies. To meet this trend, the separate room end wardrobe is meeting with much favor. This room may be separated from the classroom by a half-height cupboard and bookcase. The low height permits sufficient light to pass over the top of the cupboard to light the wardrobe well. The cupboard may have deep shelves at the bottom, for storage of the largest sizes of project work, and narrow shelves above for storage of books and supplies. This type of wardrobe permits a better circulation of the pupils in the classroom, renders it possible to avoid congestion when getting cloaks, multiplies the storage area many times, eliminates the use of all other closets in the classroom, and reduces maintenance and operating charges to a minimum.

In General. A large maintenance expense is always introduced in schoolhouses where classroom display work, pictures, maps and charts are fastened to the wood trim and walls with pins, tacks, nails and stickers. Picture moulding should be furnished throughout the building, and no pictures should be hung except from this moulding. Means should be provided above the blackboard frame and below the chalk rail in every classroom, and display work should be hung by small clamps.

Schoolhouses are being built to last for 50 years or more. It, therefore, behooves the schoolhouse architect to equip his building with appurtenances which will have an equally long life under severe usage. Under this heading fall hardware, which should be of standard stock designs, strong and durable; kick-plates at the bottom of all doors to withstand the agile boot toes of children in a hurry; door checks to prevent doors from slamming, which is not only distracting but involves a severe strain on the doors and casings; natural slate blackboards, which will outlast the building itself, and when in need of resurfacing can be inexpensively rehabilitated with a piece of pumice stone or a common brick at a cost of less than five cents a square foot; balustrades, which may be built of reinforced concrete and made an integral part of the stairs themselves and never require any maintenance outlay, especially if the handrail brackets are anchored clear through the thickness of the balustrade and bolted; and a multitude of seemingly minor details, inconspicuous in themselves but which, when assembled in a composite list, constitute a formidable array of features indispensable in schoolhouse construction and equipment.

These are some of the items in connection with schoolhouse construction,—the selection of materials and maintenance cost,—which are receiving the analytical attention of all progressive school superintendents and architects. In addition, there are many items of mechanical equipment and educational equipment which are deserving of as careful study and selection as is given the items entering into the building construction, in order that much unnecessary expense in both original cost and subsequent operation and maintenance cost may be avoided. As it becomes more and more difficult to secure the enormous sums of money needed to meet the growing cost of public school activities, the first form of pressure that has been brought to bear is the demand that a saving be made on the material side,—the building construction side,—so as to release more of the available funds to the instructional side of education. This movement has brought the members of the school board, the superintendent and his assistants, the architect and the engineer into closer contact than ever before in the history of the public schools. Each has his important part to play in the great business of education.



Room End Wardrobe. Toilets Are Omitted in Some Cases, and Teacher's Unit Occupies a Portion of the Window End

Minneapolis Bureau of Buildings of Board of Education, Architects

HEATING AND VENTILATING THE SCHOOL

BY
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THE unusual interest aroused in 1923 by the publication of the "Report of the New York Commission on Ventilation," which interest still continues, is sufficient warrant for an article reviewing the present status of school heating and ventilation from the standpoint of the architect.

The Present Situation. Since the beginning of the century and up to the year 1920, the several methods, or so-called "systems" of school ventilation were considered reasonably standardized. During the last 25 years the newer thought had evolved the broader idea of what is now termed "air conditioning," involving something more than the supply of warmed air; but for various reasons its application to school ventilation had made but little progress. In the latter half of the decade from 1880 to 1890, the results of research work by Pettenkoffer, confirmed by similar work carried on by French and English scientists, began to take practical form in an effort to supply a given volume of air to the pupil. The theory then advanced as the result of the research of that period seemed to indicate the need of supplying 30 cubic feet of fresh air per minute to each occupant of a schoolroom,—not that all of the 30 feet was deemed necessary for the actual need of the pupil, but rather for lack of known means of procuring proper diffusion throughout the occupied space and consequent dilution to a standard condition of purity.

Just here it is well to draw attention to the fact that no standards of air volume and purity have ever originated with the engineer or the architect. On the contrary, such requirements have always been laid down by the biologist, physiologist and their followers in the medical profession. There are today many among the same professions who would relegate the work of the past delvers into this particular branch of science to the limbo of those scientific truths that are not so. The subject, therefore, is at the moment highly controversial, but soonor or later the present fog of uncertainty will be lifted, and a rational scheme of school ventilation will probably be evolved which the writer suspects will measurably differ from the extreme positions now occupied by both parties to the present controversy.

If ever the medical profession, the physicists and the hygienists agree among themselves as to the proper atmospheric conditions to be maintained in our schools, the architects and engineers may be depended upon to fully meet the newer requirements. But before ignoring the sign posts of the past, reckoning them as entirely worthless, let the truth be ascertained by those best qualified for the task. This means broad-minded research by those branches of the medical profession qualified by some experience other than that of the laboratory, and it is gratifying to know that at this time wholehearted efforts looking to a better understanding of the primary relation of fresh air to the health of the pupil are under way. As a hint to the school teaching profession, the engineer and architect and those not specially trained in the biological aspects of the subject, it would be the part of wisdom to reserve judgment with that modesty inspired by ignorance, until those better qualified than themselves reach a solution of the problem. With this brief review of present status on the subject, it may be well to consider the surviving schemes of school ventilation, for upon some or all of them must we still rely until such time as we shall know of something better;—keeping in mind also that those states heretofore having laws or regulations governing the matter have so far failed to remove them from their statute books.

The School Unit. In a short article a full discussion of all the controlling factors is impossible; therefore only the school unit,—the classroom,—will be considered. If the class and recitation rooms are properly warmed and ventilated, the other school apartments can be readily disposed of, and these will be briefly considered later on.

Systems Available. There are today probably not more than a half-dozen so-called systems of school heating and ventilation worthy of consideration, and these will be briefly described, omitting consideration of the one-, two- or three-room rural schools wherein the ventilating stove or the warm air furnace is usually found which affords reasonably good results where properly installed and operated. These small schools constitute by far the greater number, taking the country as a whole, and deserve greater care in design than is usually accorded them.

In the larger school buildings steam or vapor systems of supplying heat are generally employed. Vapor heating, it may be said, is nothing more or less than heating by steam at very low pressures, say not to exceed 8 ounces. In its simpler forms, no moving machinery, pumps, and the like are required for their successful and satisfactory operation; therefore, starting with the assumption that steam is to be the heating medium and for classrooms to accommodate about 40 pupils, the systems in more common use today are:

1. The gravity indirect system of heating with gravity ventilation.
2. The plenum fan system, better known as the "straight" or control fan system.
3. The "split" system.
4. The unit ventilator system.
5. The so-called "open-window system."

The Gravity Indirect System. This system is

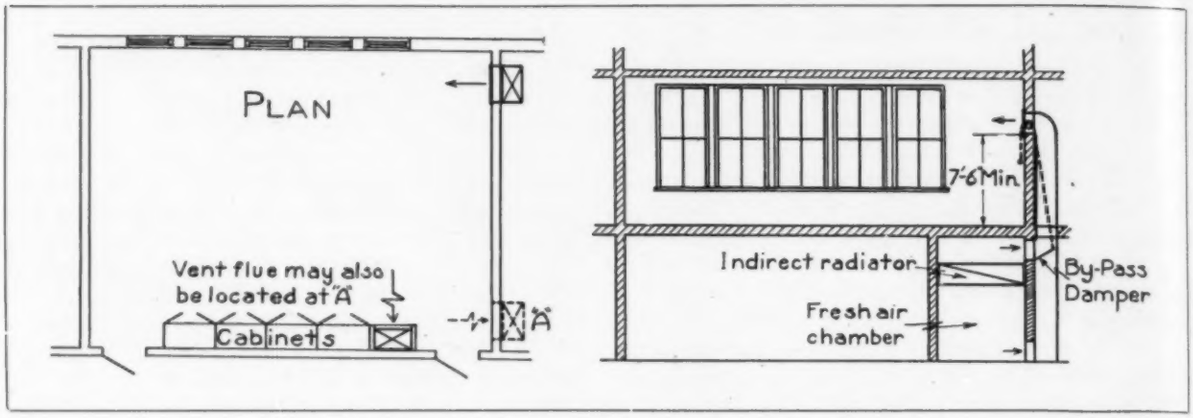


Fig. 1. The Gravity Indirect System of Heating and Ventilating

rarely used today in other than small buildings of from 4 to 12 rooms. It is one of the least valuable of the survivors of early experiments. It consists of a single flue for supplying warm air to the room and a single exhaust flue. In the basement there is installed an indirect radiator placed about 20 inches below the ceiling and just to one side of the warm air flue. Fresh air from outside is brought to the radiator where it is heated, passing thence to the room. A mixing damper is so placed at the base of the warm air flue that the temperature of the room may be kept at the proper point. The warm air, in volume (according to accepted standards) equal to 30 cubic feet per minute per pupil, should enter the room not less than 7 feet above the floor, and this flue should be placed in the same wall or in a wall adjacent to the exhaust flue. The opening into the vent flue should be at the floor. Neither flue should be on an outside wall, nor should the flues be on opposite walls.

Occasionally in this system, direct radiation is also installed in the room, but while the heating results may thereby be simplified, it is inevitably at the expense of the ventilation, due to the lower temperature required in the fresh air supplied, keeping in mind that the volume of air supplied by this system is dependent upon its temperature. The velocity of the air in the flues may be taken as 300 feet per minute in a two-story building. This velocity will be exceeded in very cold weather, thereby supplying more than the required volume of air, but in average winter weather the velocity is likely to be much less, with correspondingly less ventilation. than any other.

The advantages of this system are: 1. It is usually low in first cost, probably lower than any other. 2. It is simple to operate and usually not extravagant in fuel consumption. 3. Maintenance costs are reasonably low.

The disadvantages are: 1. That it usually precludes the use of the basement for any purpose other than boiler and coal space and playrooms. 2. It is unreliable in results, as the supply of fresh air to the rooms and consequent ventilation are dependent wholly on the outside temperature. The result is that official inspectors are not required to test for air supply and ventilation when there is less than 40° difference between the outdoor temperature and that of the air entering the room. That, in practice, usually means a deficiency in ventilation when the outdoor temperature is 35° to 40° or higher; ventilation by such a system is inadequate for at least half the heating season. 3. Its difficulty in keeping the indirect radiators and flues clean.

The Plenum Fan System. Considered simply from the standpoint of positive ventilation attained, good diffusion throughout the occupied space, and heating results generally, this system in the average sized school leaves little to be desired. Unfortunately, however, the fan cannot well be kept running during the night, resulting in there being a cold building in the morning, and requiring considerable time to get the walls up to room temperature and comfort. This condition also results usually in high fuel cost, and for that reason this system is infrequently employed. It has the advantage, however, of supplying at all times when heat is required, an adequate degree of ventilation, for in order to keep warm, the school authorities necessarily have to supply air for ventilation.

In designing a building for this system, the same arrangement of flues would be followed as outlined for use with the gravity indirect system previously described, except that the warm air flues may be proportioned for a higher air velocity say 400 to 450 feet per minute; but the openings into the room should be kept down to 300 to 350 feet per minute in order to avoid objectionable drafts. In some states 300-foot velocity is the legal maximum for a standard-sized classroom. In this system the location and size of the vent flue remain as previously described for the gravity indirect system. The supply ducts from the fan, usually in the basement, may be of a size permitting much higher air velocities, reaching 800 to 1000 feet in main ducts, and in branch ducts to base of upcast warm air flues of from 500 feet to 700 feet.

For heating the air before delivery to the rooms,

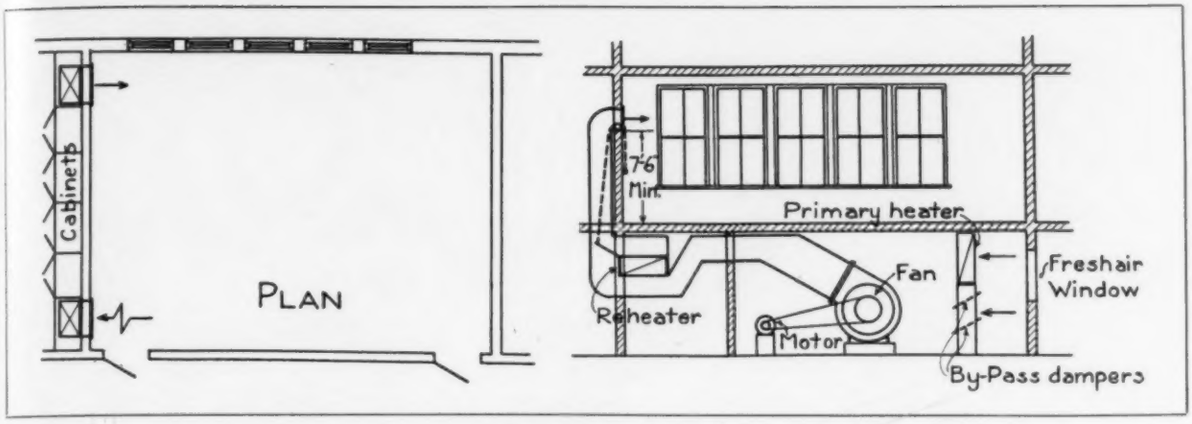


Fig. 2. The Plenum Fan System of Heating and Ventilating

an indirect radiator, or "Stack," so-called, is usually placed at the base of each warm air flue with a by-pass or mixing damper permitting temperature control either manually or from a room thermostat. In this arrangement the air at outdoor temperature is blown by the fan through ducts to the radiators where it is raised to whatever temperature may be required by the different rooms. In a modified and somewhat better designed installation the outdoor air may first be warmed by radiators or primary heater to 50° or 60° as it enters the fan chamber, and thence is delivered to the re-heaters at the base of the warm air flues as just described. In extremely cold weather, in order to maintain 68° to 70° room temperature, the temperature of the air as it enters the rooms might be as high as 115° (or even more) on the exposed side of the building, while at the same time it might not exceed 95° to 100° on the sheltered or sunny side. In the afternoon, with the sun farther around in its daily cycle, this condition may be found reversed, showing the need of adequate means for controlling the room temperature under all weather and exposure conditions.

All in all, the straight central fan system has much to offer in its favor, and were it as economical in fuel consumption as some other systems, it would no doubt be more generally installed. The advantages of this system are: 1. That it is reasonable in first cost. 2. It is adequate in heating and ventilating results. 3. Its maintenance or cost of upkeep is low.

The disadvantages are: 1. That it means continuous power expense, but no greater than in any other mechanically-operated system. 2. In cold weather some difficulty is frequently met in average building construction in getting the walls of the rooms up to a temperature that will not cause a feeling of chilliness to those sitting near them, although the air temperature may indicate 68° to 70° on an inside wall. 3. It is generally uneconomical in fuel requirements.

The "Split" System. This mechanical system is perhaps that most commonly employed in schools of considerable size, for with all its defects it does provide facilities, *where properly operated*, for adequate heating and ventilation according to present standards. It combines the use of direct radiation placed along the outside walls beneath the windows with a positive fan supply of fresh air warmed to from 70° to 80°, with the exhaust flue of usual size and location. It provides the air diffusion so greatly desired.

Alas, however, its very flexibility often defeats the virtue of its employment, for the frugally minded public authorities and that well known official, the janitor, severally or jointly contrive in average winter weather to heat the school rooms from the direct radiation only, without the use of the fan, thus saving fuel, but providing no adequate degree of ventilation. In this system the permissible air velocities through ducts and flues would be the same as in the plenum fan system. The location and use of the indirect surfaces (radiators) likewise are the same, but the degree of heat to be obtained thereby may differ from the preceding illustrations. In some cases the primary heater may be designed to heat all of the incoming air to from 60° to 80° which with the direct radiation in the rooms, usually proves sufficient regardless of north or south exposure. This is especially true where the direct radiators are under thermostatic control, it being understood that the primary heaters are similarly controlled. In larger buildings or in those where varying temperatures are needed in certain rooms, the tempered air at the fan may be only 45° to 60°, and in such cases a reheater is placed at the base of the warm air flues serving to raise the temperature of the air delivered to the rooms to the desired point. This latter arrangement requires, in order to afford satisfactory results, the use of thermostatic control of the radiators both primary and direct. Occasionally, also, there may be found in this system the installation of one or more fans connected with the exhaust flues. Their use would not alter the location of the exhaust flues, but would permit higher velocities therein, say up to 450 to 500 feet per minute where the exhaust fans are to be depended upon at all times. The inlet velocity from the room to the exhaust flue should not, however, exceed 300 feet per minute to avoid uncomfortable drafts at the floor.

Where direct radiators are placed under the win-

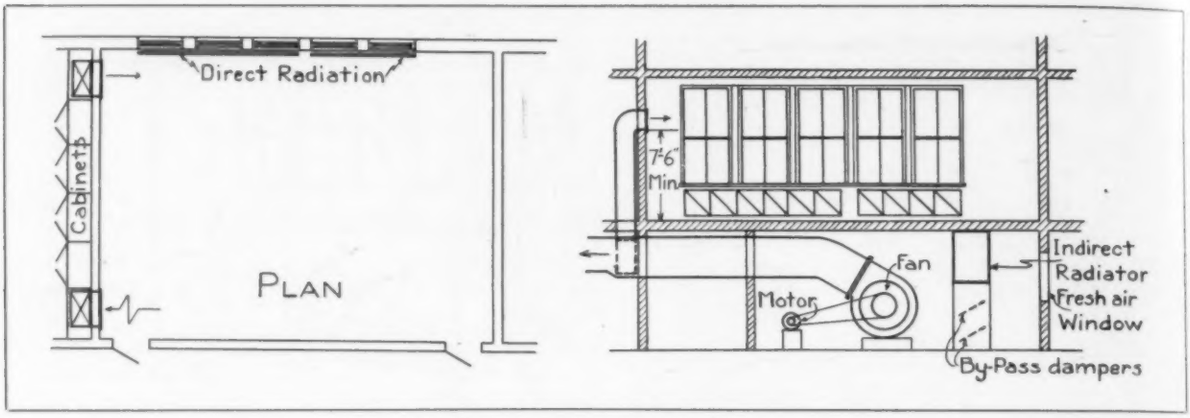


Fig. 3. The "Split" System

dows alongside the outer row of desks, complaint is often heard of the excessive heat to which the pupils are subjected. A sheet metal shield may be attached to a radiator extending from a point about 6 or 8 inches above the floor to the top of the radiator, and thus afford the desired protection. With this system the arrangement of the flues and their relation to the classroom would be as shown in Fig. 2.

The advantages of this system are: 1. Its being very low in fuel consumption. 2. That it is simple to operate, flexible. 3. Its being low in upkeep or maintenance costs.

The disadvantages are: 1. That installation costs are greater than for a gravity indirect or plenum fan system. 2. That from its very flexibility it is too easily subject to human manipulation in the sole interest of fuel economy.

The Unit Ventilator System. This is one of the most flexible systems known, combining in the individual classroom everything needed for its satisfactory heating and ventilation other than the boiler and pipe connections. The installation consists essentially of an indirect radiator; a small fan for the positive supply of fresh air taken from without the building through a wall opening; a fractional horse-power motor for the fan propulsion; all contained within a substantial metal enclosure. Usually a direct radiator also is placed against an outside wall to supply the heat necessary to compensate for that lost through wall and glass surfaces. A suitably placed damper excludes the air from outside when school is not in session, and a by-pass damper in the unit heater is employed to regulate the room temperature either manually or by thermostat.

All unit ventilators, so-called, are provided with means for recirculating the air from the room through the device and for the exclusion of fresh air from outside. This type also strongly appeals to those civic authorities having an eye solely to the conservation of fuel, for in practice the unit ventilator will frequently be found shut down, and for heating the room, dependence will be placed on the direct radiator; or perhaps the device may be used to recirculate the warm air in the room with no fresh air supply. It is often best to specify that the recirculating feature be omitted, and where possible, that the direct radiator be also omitted from the room, thus assuring positive ventilation, at least whenever heat is required. Some unit ventilators operate upon the high velocity jet principle, the air leaving the unit directed toward the ceiling and at velocity varying from 800 to 900 feet per minute. These high velocities secure ample diffusion and equality in temperatures throughout the room.

Efficient installation requires that the unit be placed near the source of fresh air, as on an outside wall, with the exhaust on an inside wall located as far from the unit as possible. The exhaust flue may be proportioned for a higher velocity than is permissible in other gravity exhaust systems, say as high as 600 to 700 feet per minute, the flue being carried through the roof in the usual manner.

The advantages of this system are:

1. That each room may be treated as a unit, in no way dependent upon any other room for its successful operation. This is of greater importance in high schools than in the lower grade schools.

2. It affords a positive supply of fresh air to the rooms, properly warmed and generally well diffused.

3. It eliminates the warm air flue and connecting basement ducts of either masonry or sheet metal.

4. That the units are reasonably quiet in operation.

5. Maintenance or upkeep costs reasonably low.

6. That fuel cost is about the same as in any systems supplying an equivalent volume of outdoor air.

Its disadvantages are: 1. That it involves a higher initial cost than the other systems here described. 2. That it requires a multiplicity of small fans and motors to be looked after and kept in repair. 3. That it takes up some space on the outside wall of the classroom, varying from 14 inches to 20 inches from the wall and from 3 feet to 4 feet in length.

The "Open Window" System. This means a new adaptation of an ancient unsuccessful attempt to ventilate school rooms, which a former generation endured and then happily discarded. This observation must by no means be construed as an indirect expression of opinion concerning the merits of the

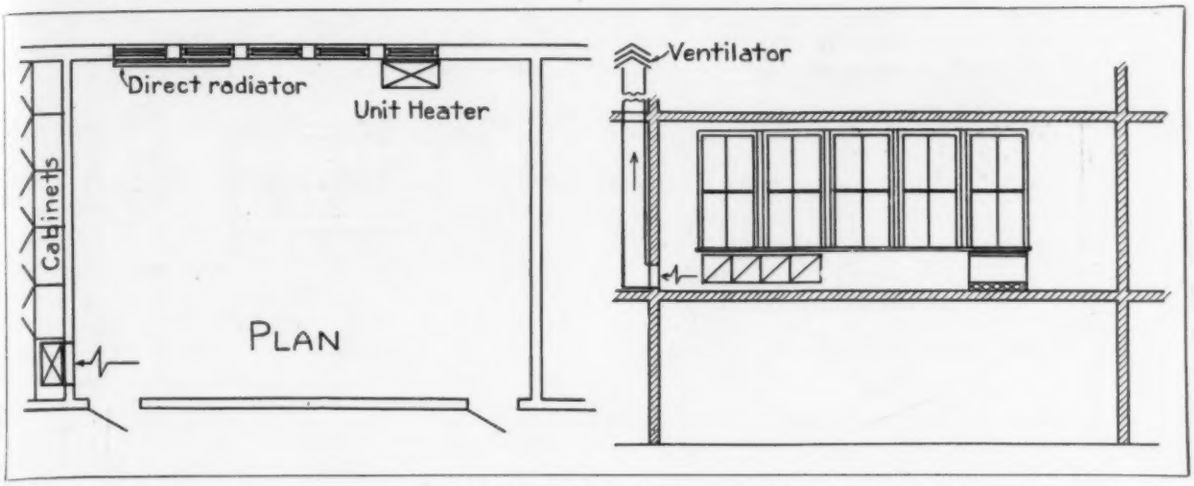


Fig. 4. The Unit Ventilator System

controversy now in full swing as to what constitutes the proper air conditioning of schools. It is just a plain statement of fact, as any observer of the conditions existing in urban schools of the early 90's can testify. Neither is the system referred to herein for any reason other than to acquaint the architect with its salient features.

In its entirety this system consists of just two exhaust flues, each of 4 square feet area, and of one or more radiators having a total surface of from 250 to 300 square feet. Each exhaust flue has an opening at the floor and also one at the ceiling. No means for creating a movement of air in these flues is advocated by the proponents of the system. Hand control only of the radiators is permissible. Deflectors at the window sills give direction to the increasing air when the lower sash is raised. In *theory* the incoming air (with the wind from the right direction) is warmed from the radiators, is deflected to the upper part of the room, and passes out through the upper openings into the exhaust flues; but if by chance the air falls, then opportunity is afforded for its passage into the exhaust flues at the floor. In this natural process of diffusion, drafts are ever present. Perchance luck may favor the anæmic (by no means rarely) in having for a teacher one whose comfort zone hovers around the 80° median, in which case the windows stay down. In *practice,* with the wind blowing from some other direction, expired and fresh air from other rooms and sources reaches the classroom under consideration via the corridors, or perhaps down the exhaust flues, thence, after being duly warmed by the radiators, passes out of the windows. This, of course, assumes that the windows are open, but usually for some reason or other they are kept closed. That the windows will be found in large part closed when the outside temperature is below 50°, is not an idle statement concerning the usual manner of operating the ventilation of such schools, *after* the investigating commission or other authority has completed its occasional or periodical survey. It should also be unnecessary to say that during such a survey the system is, of course, operated the way it was intended to be, but the same may as truly be said of any other system under similar circumstances. This system is not suitable for assembly halls, gymnasiums or classrooms accommodating more than 40 to 50 pupils.

Briefly, the human element in the operation of schools equipped with this system reacts in precisely the same fashion as in schools otherwise equipped, but with this difference: that when an "open window" system is installed there is an absence of control over the volume, temperature, humidity or any other desirable (yet to be determined) quality of the air the pupils breathe. If the room gets too cold, the remedy is to close or partially close the windows, and incidentally cut off or reduce the supply of fresh air.

The advantages of this system are:

1. That installation cost when properly installed, is about 10 to 15 per cent less than for a "split" system. 2. Its upkeep or maintenance cost is low.

Its disadvantages are:

1. That no control of proper air conditions is assured. 2. That to maintain the best room conditions with this system requires the constant and intelligent watchfulness of the teacher, and takes her from her legitimate duties. 3. Its fuel consumption is fully as great as in a well designed "split" or unit ventilator system, either of which will provide under all weather conditions from two to three times as much ventilation.

The Auditorium. Such rooms cannot well be standardized as to their heating and ventilation, varying as they do in design and outside window spaces. Those with small exposed walls and few windows usually require the supply by positive means, of fresh air, with of course means of heating. The air supply to auditoriums where not governed by official regulations, may be much less than in classrooms, owing to the usually shorter periods during which they are occupied. Based upon the full seat-

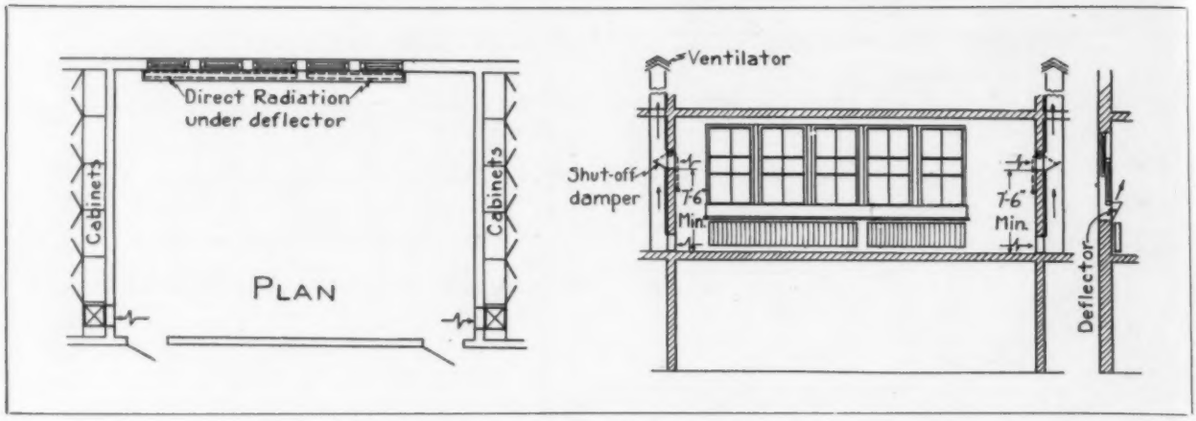


Fig. 5. The "Open Window" System

ing capacity,—allowing 6 square feet floor and gallery area per occupant,—the supply of from 10 to 15 cubic feet of fresh, warmed air per minute is considered sufficient. The temperature of the incoming air should be under thermostatic control, and it is desirable also, that the direct radiators should be similarly controlled. On the score of fuel saving, direct radiation should be installed in sufficient amount to keep the walls and furniture warmed.

Where there is an abundance of window space, and especially an opportunity for cross ventilation, roof ventilators for the relief of an overheated room, due to a combination of a large audience and mild weather will seldom be required. The warm air flues should be of an area for an air velocity of from 350 to 500 feet per minute, with a velocity through the openings into the auditorium varying from 350 to 500 feet per minute, depending upon the height from the floor to the bottom of the warm air grille. The flues may be located at one or more points in the room, and in some cases the exhaust may be taken through the front of, and under, the stage, if any, there connecting to upcast flues to ventilators or fans on the roof. Where an exhaust fan is installed, the exhaust flue velocity may be from 500 to 700 feet per minute.

Gymnasium. Such a room, in the absence of official regulations, would be heated and ventilated much the same as an auditorium, but owing to the character of the exercises, greater reliance can be placed upon window ventilation, and such a room should not be heated above 60° unless it is to be used as a combination gymnasium and auditorium.

Swimming Pool and Shower Rooms. There should be sufficient direct radiation properly installed and controlled, to maintain 80° temperature with adequate ventilation, either through exhaust fans or ample gravity exhaust flues. Fan supply of fresh air is rarely desirable in such rooms. Dependence for ventilation should be placed wholly upon the exhaust, with inlets for gravity supply of warm air.

Dressing and Locker Rooms. These should be warmed by direct radiation to about 70°, and there should be ample exhaust, preferably by fans.

Toilet Rooms. Such rooms with one or two fixtures, if located with ample outside windows, are seldom provided with special means of ventilation. General toilet rooms should be ventilated by means of fans to the extent of eight to ten air changes per hour, and heated by direct radiation only to about 65°.

Plant Operation. No matter how well a heating and ventilating plant is designed and installed, unless there is to be coöperative effort on the part of the school and town or city authorities, the best results from the installation will rarely be obtained. Whatever may be the final decision concerning the proper atmospheric conditions to be maintained in schools, so long as the authorities place fuel saving above the health of the pupil, or the janitor is inefficient and incompetent, anything but satisfaction is to be expected from any installation. In the final analysis, however, it is the public that must be brought to realize the facts,—by educational methods,—and to insist upon an adequate return for the expenditure of public funds.

Auxiliary Equipment. No mention has been made of air washing, humidifying or ozonating apparatus, and but brief reference to automatic temperature control. These auxiliaries are essential in many instances, but they require more space for their adequate description than can be accorded in this article.

THE ARTIFICIAL LIGHTING OF SCHOOLS

BY
D. J. FRANDSEN
ELECTRICAL ENGINEER

THERE are certain quite fundamental and obvious reasons why artificial lighting should be provided in all schools. Perhaps the most important of these is the fact that provision must be made for those inevitable cloudy or stormy days, which, in some localities, comprise such a startlingly large percentage of the school year. The increasing prevalence of night schools and the fact that the school building is often used for various community meetings, in addition to school activities, are direct evidences of the need of artificial light.

Of all the facilities placed at the disposal of the school child, good lighting is one of the cheapest. The *American City* Bureau reported a few years ago that the average cost of teaching each child, per year, was $57. The average child will reach the eighth grade at the age of 14 years, at a cost of $456 to the state. If, on account of defective vision caused by poor illumination, or slowness due to lack of visual stimulus, the child reaches only the sixth grade, the cost to the state has been the same, with only three-fourths the result. The state loses money, and the child will probably leave school poorly prepared to earn a living. At an estimated cost of less than $1.50 per child, per year, good illumination, which would tend to greatly decrease eye troubles and resultant backwardness, can be provided.

Lighting and the Eyes. That defective vision is frequently acquired and is often progressive is shown by the fact that eye troubles are more prevalent among children in the advanced grades. For instance, 10 per cent of the children entering school are near-sighted, while about 33 per cent are near-sighted at the end of their eighth year. That adequate illumination can offset to a great extent the handicap of defective vision was effectively demonstrated in a test conducted on a group of public school children who were decidedly backward in their studies. These children were observed under various intensities of artificial illumination, and a marked increase in mental alertness was noticed as the amount of illumination under which they worked was increased. This improvement in work continued until a maximum illumination, in the neighborhood of 17-foot candles, was reached. The results of this single test are in line with the results of other tests, and indicate that higher standards of illumination are desirable, and that the present standards of illumination for classwork are by no means final and may require future revisions. Progress of the children under the higher standards of illumination was so gratifying that specially lighted classrooms have been installed for their benefit.

Unlike home lighting or office lighting, school lighting is likely to remain unchanged for a long time, even if it is unsatisfactory. The architect must use care to insure permanent utility by correct design and planning consistent with the needs of the school.

Lighting Requisites. Before entering into any descriptions of the methods of securing proper results in school lighting, it will be well to consider a few of the desirable qualities of good illumination, and then to show by illustrations and data examples of these principles applied to typical buildings. The requirements of lighting are few, but important:

1. Adequate Light. Sufficient illumination for the work at hand; too little light is productive of eyestrain, fatigue and consequent poor work, and may be the cause of permanent eye trouble.
2. Elimination of Glare. This point cannot be overemphasized.
3. Diffusion. Sharp shadows and harsh contrasts should be carefully avoided.
4. Distribution. This point must receive careful attention if good lighting is to be obtained.

In considering the first point, it is evident that a suitable amount of light must be supplied if work of any kind is to be properly performed. Regardless of what type of lighting system is used, a sufficient amount of light must reach the work,—otherwise the system must be considered as inadequate.

Standards of Intensity. The unit ordinarily used in speaking of the illumination on any surface is the foot-candle (defined as the illumination on a surface normal to a one-candle power source at a distance of 1 foot). This value is measured with a foot-candle meter or other portable photometer. The values given in this table have been found from experience and observation to be desirable standards of illumination of schoolrooms:

Classrooms	8- to 12-foot candles on desks
Study Rooms	10- to 12-foot candles on desks
Offices	10- to 12-foot candles on desks
Drawing Rooms	15- to 25-foot candles on tables
Laboratories	8- to 12-foot candles on tables
Cloak Rooms	1- to 3-foot candles on floors
Corridors	2- to 5-foot candles on floors
Auditoriums	3- to 6-foot candles on floors
Auditoriums (if used for study room purposes)	8- to 12-foot candles on chairs

While such values as given here will produce satisfactory results, the application of the higher rather than the lower values might be advisable. With the higher values of illumination increased perception is obtained, and better results may be expected.

Diffusion and Glare. Sufficient diffusion and the elimination of glare are of importance in any lighting system, yet nowhere are they more important than in the schoolroom. Practically all commercial light sources are far too brilliant to be directly in the field of vision without causing a blinding effect and reducing the ability to see. The construction of our buildings places definite limits upon the heights at which lamps may be hung. We must,

Special Lighting for Pupils with Defective Vision. Average Illumination, 15-Foot Candles

Room 24x30x13 Feet. Average Illumination of 15-Foot Candles Is Provided by Eight 300-Watt Lamps

Guilbert & Betelle, Architects

therefore, always reduce the brilliancy of the light sources by means of diffusing globes, shades or reflectors, which either effectively enlarge the light sources or actually hide them from view. Diffusion is necessary in order that shadows be softened and harsh contrasts be eliminated. It is not desirable, however, to go to such an extreme of diffusion as to entirely eliminate shadows, for they are essential in showing the contours or shapes of objects.

The walls, ceilings and woodwork have a very large effect on the efficiency of a lighting system, and upon the way in which the light is distributed. In general, it is advisable to provide walls of a moderate reflection factor, the preferred colors being light gray, light buff, dark cream and some tints of green. Ceilings should have a high reflection factor, either a flat white or light cream color being suitable. In order to eliminate annoying reflections, desk tops and other woodwork should have dull rather than glossy finishes.

Distribution of Light. The fourth point to be considered in designing a lighting system is that of the distribution of light. We have, in general, two extremes,—local lighting and general illumination. In local lighting relatively low-wattage lamps located close to the work furnish a high level of illumination over a small area. Such lighting has very limited applications, none of which are found in the school. A system of local lighting usually abounds in those conditions which cause eye strain and eye fatigue. In general illumination, much larger lamps are used, these lamps being hung as high as possible in order to get them out of the field of view, and in order to provide good distribution. General lighting is, without question, the system best suited to schoolroom lighting. The wiring costs are lower, and the efficiency of the system is higher, due to the fact that higher-wattage lamps are much more efficient than low-wattage lamps. Proper location of outlets insures almost uniform distribution of light throughout the room; in fact, there is possible a much more uniform distribution than with daylight.

This table, taking the light from a 100-watt lamp as unity, indicates the relative amount of light which may be expected from the higher wattage lamps:

100-watt, inside-frosted lamps	1
150- clear lamps	1.75
200- " "	2.45
300- " "	4
500- " "	7.2

It is essential that light should be directed on the object to be seen and not directed to the eye; therefore, since it is necessary to hang lamps high and out of the line of sight, we must equip them with reflectors or other devices in order to direct the light to the desk or to the ceiling to be re-directed downward.

Types of Lighting Fixtures. Direct, semi-indirect and totally indirect systems are all employed for school lighting. Each has certain inherent advantages, although they are all satisfactory if properly applied. Ordinarily more outlets are required for direct lighting, in order to obtain proper distribution and diffusion, than are needed for either the semi-indirect or the totally indirect systems. This is offset to some extent by the fact that direct lighting by enclosing diffusing globes is ordinarily more efficient than either of the indirect systems.

Indirect Lighting. Totally indirect lighting produces an extremely good quality of illumination, but it is somewhat less efficient than direct lighting with enclosing globes. In general, the illumination from a totally indirect or semi-indirect installation is about 66 per cent of that which would be produced by a direct lighting installation, using enclosing globes, if the same size and number of lamps were used in each case. A very light colored ceiling is absolutely essential if indirect lighting is to be used to best advantage, since with dark colored walls and ceilings, a larger percentage of light would be absorbed and the over-all efficiency of the installation would be considerably lowered. With indirect lighting there is little possibility of glare, and the resultant light is quite soft and free from shadows; glaring reflec-

Totally Indirect Lighting Provides 10-Foot Candles at Chair-tops

Semi-Indirect Lighting Provided by Four 300-Watt Frosted Lamps

St. John's Law School, Brooklyn

tions are reduced to a minimum, and there are no very severe contrasts to tire the eye. The principal objection to indirect lighting, other than from the standpoint of initial efficiency, is that bowls tend to accumulate dust, making frequent cleaning necessary.

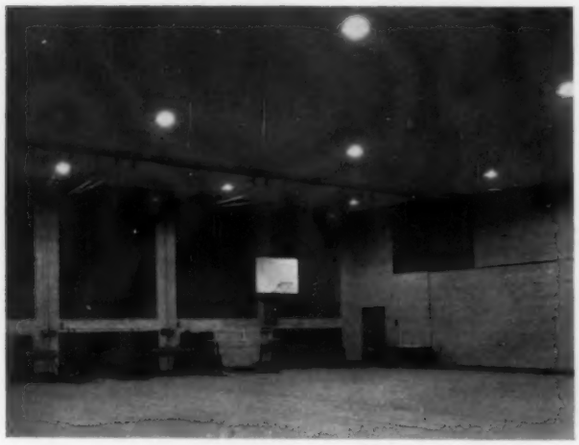
Semi-indirect Lighting. The luminaire employed in this type directs the greater part of the light toward the ceiling (as in the totally indirect system), yet a small portion of the light is permitted to pass downward through opal or frosted glass. This downward light serves the purpose of illuminating the luminaire so that it does not stand out as a dark spot against the lighted ceiling area. The directional quality of this downward light has, in some cases, an added advantage, in that it serves to emphasize to a slight extent shadows which might be wholly lost under totally indirect lighting. Semi-indirect lighting is slightly more efficient than totally indirect lighting. The resultant illumination is well diffused, and such shadows as are produced cause no annoyance. The better forms of semi-indirect units employ dense glass or some other means of reducing the brightness of the lighting unit. This type of lighting is particularly well adapted to schoolrooms, especially if the totally enclosing type of semi-indirect luminaire, of which the upper portion is of clear glass, is used. The open type, semi-indirect units are open to the objections applied to totally indirect luminaire as regards accumulation of dust.

Direct Lighting. Open-bottom direct lighting units are found in many of the older installations. These units are obviously efficient from the standpoint of light output, but their other characteristics are not such as to make them suitable for use in the schoolroom. The diffusion is not of the highest order, and sharp shadows and contrasts are likely to be extremely prevalent. Such units are also objectionable from the standpoint of direct and reflected glare, especially if clear bulb lamps are used. The use of this form of lighting is advisable only where cost must be kept at the absolute minimum, and where secondary consideration is given to the quality of the light. If such lighting is employed, it is advisable to use dense opal or etched prismatic glass deep bowl reflectors. Such reflectors will not produce an unpleasant glare. Flat type reflectors, of either metal or glass, should never be used in the schoolroom, for it is almost impossible to conceal the lamp filaments from view when this type of equipment is employed. Opaque reflectors, in general, are unsuitable, since the ceiling would be very dark if they were used. Diffusing bowls or white bowl lamps should always be used in preference to clear lamps if open-bottom lighting units are installed.

The enclosing, diffusing, direct lighting luminaire or enclosing globe seems to quite satisfactorily fulfill all of the major requirements of classroom lighting. If the proper type is chosen, a well diffused illumination, free from direct or reflected glare, is produced. With this type of equipment the major portion of the light is directed downward, although a considerable portion is transmitted upward, thus giving a character of illumination somewhat similar to that produced by semi-indirect units. The equipment is easily cleaned, and, in general, does not depreciate as rapidly from dust accumulation as do other fixtures giving comparable qualities of illumination. Of course, cleaning should never be neglected, for it is only from clean lamps and clean accessories that maximum light output is obtained.

Ventilating the Fixture. The question as to whether or not it is necessary to provide ventilation for totally enclosing units is one that has often been raised. The results of carefully conducted tests have indicated that with a sufficiently large radiating surface, in other words the proper size of globe and fixture, ventilation is unnecessary.

Globe Sizes. In making a choice between commercial types of equipment of any one class, there are a number of factors which must be given consideration. With the enclosing globe, one very important element is the brilliance of the glassware. This depends on the character of the glass, the size of the globe, and the wattage of the lamp used. The



Mirrored Glass Reflectors, Recessed, Provide 6-Foot Candles Using 300-Watt Lamps

Guilbert & Betelle, Architects

Prismatic Glass Direct Lighting Luminaries; Illumination 10-Foot Candles

Schenck & Williams, Architects

diffusion should be such that the entire globe will be quite uniformly lighted when the proper size of lamp is used. There should be no bright spots opposite the filament. Assuming that the globe gives good diffusion, the brightness will then depend on the diameter of the globe and the size of the lamp used. Care should be taken to provide globes of a sufficient size to care for the lamp used. Glassware designed for 200-watt lamps will accommodate lower wattage lamps quite nicely, but a globe which might be entirely satisfactory with a 100-watt lamp would probably be unsatisfactory with a 200-watt lamp.

This table indicates the minimum desired diameter of enclosing globes, the diameter to be measured at the point of maximum width:

With	100-	watt	lamps.....	12	inches
"	150-	"	"	14	"
"	200-	"	"	16	"
"	300-500-	"	"	18	"

With light colored surroundings there is comparatively little choice between the various fixtures of the type under consideration as to shape, since the light walls and ceilings will be of material assistance in redirecting and diffusing the light. In general, an enclosing globe (of opal glass) will give off the major portion of the light in a direction approximately normal to its greatest projected area. That is, a globe of the stalactite shape will direct the greater portion of its light toward the walls, while a globe of the squat type will be more efficient in directing the light downward. This, of course, does not apply to those luminaires in which distribution of the light is controlled by the use of prisms moulded into the crystal glass body of the luminaire.

Spacing of Luminaires. The location of the luminaire in a classroom as well as in any other room depends upon the dimensions of the room and the type of lighting which is to be used. Indirect and semi-indirect systems permit of a slightly wider spacing than would be satisfactory if enclosing diffusing globes were to be used. With direct lighting from enclosing globes or reflectors, the spacing should never greatly exceed the hanging height of the luminaire. Ordinarily this spacing may be increased to one and one-half times the hanging height; if semi-indirect or totally indirect lighting is employed, however, it is frequently found that the same spacing is necessary for either direct or indirect lighting. For instance, in a room 21 x 21 feet, with a 13-foot ceiling, four outlets would be essential if good lighting is to be obtained. These four outlets would be necessary with either direct or indirect lighting. They should be spaced on approximately 11-foot centers, about 5 feet from the walls.

The calculation of the sizes of lamps which should be used involves consideration of the type of equipment, the colors of the walls, ceiling and other woodwork, and the dimensions of the room. Direct estimates based upon an assumption of a certain number of watts per square foot of floor area are liable to lead to erroneous results. The flux of light or *lumen* method as set forth in the standard texts on illumination and in the bulletins issued by the large lamp companies, will ordinarily give more accurate results, since it is based on the light output rather than the power consumption of the lamps.

Lighting of Gymnasiums. The lighting of those various rooms other than classrooms which are found in the typical school building presents no especially difficult problems. The high ceiling of the typical gymnasium makes the use of mirrored glass or other efficient light-directing reflectors quite feasible. The equipment should always be provided with suitable guards in order to protect it from possibly injury. It is becoming quite common practice to provide recesses in the ceiling in which lighting equipment may be installed. Care should be taken to avoid glaring light sources, since by their blinding effect they may become the cause of a serious fall or other injury. Shower and locker rooms may be quite adequately lighted by 100-watt lamps in opal bowl reflectors, although high percentages of moisture often necessitate the use of vapor-proof fixtures in the shower rooms.

SANITATION FOR SCHOOL BUILDINGS

BY

A. R. McGONEGAL

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THE little old red schoolhouse of fond memory has faded into history, and even its successor, the two- or three-room village school is slowly but surely giving way to the new in school building and administration. The family flivver and the school "bus," cheap, rapid and dependable transports that fairly eat the miles that were too much for sturdy, plodding little feet, have wrought the transformation. Instead of many small township and cross-roads schools, we build a replica of the city school building to care for the entire county, and we bring the children to the school instead of taking the school to the children. Thus centralizing educational facilities, the rural community obtains most or all of the advantages of the city school system.

The rural community school building and the average city school building being alike in their physical aspects, the plumbing systems of the structures will be the same. The basic principles of sanitation as applied to the theory and design of plumbing are the same whether the school be located in Maine, Minnesota, California, Texas or Florida, in a small town or in a great city. There will be slight differences in details to accord with differences in climate, such as protection of pipes. County or small town schools may not have the advantages of a public water or sewer system, but isolated automatic water systems and modern sewage disposal plants take their places, and the plumbing installations in the buildings will be identical. The really immense school structures in some of our larger cities differ from the small town buildings only in size, so that the plumbing requirements of an average school building apply to all.

Site and Sanitation. The county school usually has an advantage over the city school in the matter of site, both as to suitability and amount of ground. It goes without saying that a school should have ample space for light and air on all sides, and it should have, if possible, sufficient playground area to keep the children off the adjacent highways. A suitable location is just off the main traveled thoroughfare, as it is less noisy and the air is less laden with dust and burnt gasolene fumes, but it should be close enough for easy access. If selection is not restricted, there are but four items to consider in a site, and "two of these items are water." As the old saying goes, "good property has water as is, and water as isn't." If a city or community water supply of unquestioned quality and ample quantity is not available, it will be necessary to depend on a well, and if this be the case, the deal for the ground should not be closed until the well has been drilled and the supply found satisfactory. Before drilling the well, it is wise to make a survey of the surrounding property to see that the sanitary arrangements are such that contamination of the well is not probable in the future. The other water attribute, the "water as isn't," refers to necessity of locating the school on comparatively high, well drained ground, suitable for firm foundations and a dry basement. Low ground and marshy, spongy or waterlogged soils are hardly suitable for school sites from standpoints of either economy or health. The other two basic items are space and accessibility. Space is necessary for light and air, playgrounds, and room for future expansion, which should always be planned at the time the original building is laid out. Accessibility means not only location on a good road near the main artery of travel, but a position near the center of population of the territory served; at the shortest distance from the greatest number of families.

Basements should be well out of ground, with high ceilings, so they will be healthful gathering places in inclement weather and can be used for overflow classrooms in emergency. Outside walls should be dampproofed to grade, even if the site is ordinarily dry. The plumbing of a school, both in design and installation, should be of the very best. This is not only wise from a future repair expense standpoint, but good plumbing begets good care, and if we teach our children what good plumbing is, it makes for the health of not only the children themselves, but of the homes, the neighborhood and the nation. The school toilet rooms should be cleaner than the home arrangements, if possible, and the arrangements of the exposed fixtures and pipes should be neat, substantial and easily kept clean and in repair.

The Locations of Toilet Facilities. Suggestions for locating school toilet facilities in outbuildings are frequently made by those having little knowledge of matters connected with the health requirements of growing children and with difficulties of supervision. Such a location, whether connected with the school building by a corridor or not, adds greatly to the already heavy burden of proper supervision; adds to the expense of heating and ventilation in northern climates; and is a decided disadvantage from a health angle. Ease of access, cleanliness and comfort in responding to nature's requirements make for regularity and full and complete operation, forming a healthful habit which should continue for years to come. Dingy, frequently dirty, outbuildings, damp and cold in inclement weather, are not inviting and consequently are responsible for self-imposed abstinence which may, and undoubtedly often does, result in unnumbered cases of irregular habits and constipation, causing much misery and sickness in after life.

Children are naturally mischievous and are likely to break or mar things within their reach when not

under supervision; so, knowing that one in authority cannot be always in the school toilet rooms, we should accept the fact and contrive to create, as far as possible, conditions which will cause little satisfaction to those on mischief bent. This means having all our toilet room fixtures and equipment of substantial pattern, firmly fastened in place, and with as few exposed nuts, screwheads and other contrivances as possible on which a handy boy can use his jackknife. Rows of closets, urinals and basins should be set along the walls and not out in batteries at the center of the room, so that racing and playing tag around them will be out of the question. Fixtures and partition corners set out in the room seem to be desirable handholds and swinging posts for racing children, and many a standing partition has been torn away time after time, with recurring repair bills. Batteries of fixtures set out in the room also add to the difficulties of supervision by providing shields for those hiding from teachers passing or looking in the door. In general, it is excellent practice to lay out a school toilet room so that every portion of the room is visible from its entrance. It is also a good idea to have the entrance without doors but arranged so that the line of vision from the corridor is obscured as to any fixtures. This arrangement requires some consideration in the ventilation system so that there will always be a current of air from the corridors into the toilet rooms. Either an increased exhaust rate for the toilet room itself over the classroom rate, or definitely ventilating the corridors through the toilet rooms will take care of this.

In buildings of one story and basement it is quite customary to group all toilet facilities in the basement, or to put the boys' toilet there and the girls' toilet immediately above on the main floor, which is somewhat more economical on account of the more compact arrangement of the piping, but the best practice is undoubtedly to provide each floor with its own equipment for each sex.

Provisions for Teachers. Teachers' toilets should be provided, as well as slop or service sinks, on each floor. A kitchenette with a small sink in a rest room will be appreciated by the teachers. Extra drinking fountains should be in the basement playrooms, and pedestal fountains are often installed on the playgrounds and not infrequently in front of the building for use by the general public. Teachers should never be required to use the same fixtures as the pupils, but, on the other hand, good administration requires their presence in the pupils' rooms occasionally, and a way to insure this indirect supervisory effect is to locate fixtures for the teachers' use in private rooms opening from main toilet rooms so they must pass through one to get to the other, though other considerations may outweigh this.

Walls and Floors. Walls and floors of pupils' toilet rooms should be of non-absorbent materials with a finish not easily damaged. Buff, mottled, salt-glazed brick up to a line 7 feet from the floor has been found very satisfactory. Laid with thinly buttered joints in cement mortar without lime, these brick make a practically non-absorbent wall and one not easily scratched or marred or written on with either pencil or chalk. Ordinary cement-surfaced concrete floors are likely to be spongy and absorb moisture, giving rise to odors around the closet bases and urinals. There are a number of good composition floor materials and concrete floor hardeners on the market which can be laid with the ease of ordinary cement and troweled to a hard, glassy finish which is practically waterproof. A mastic bituminous compound has been successfully used, laid hot and ironed smooth much in the same manner as an asphalt-surfaced street pavement is laid. This material can be surface-heated and ironed smooth again if it has to be cut up or becomes worn or rough in spots.

Partitions. Wooden partition work for toilet room closet enclosures is unsuitable. Even with the best of finish, wood will absorb and will give off odors in time; even the window frames and sash should be metal where possible. There are any number of makes of unit metal closet partitions on the market. The best of these are of ingot iron or copper-bearing steel, all welded panels, factory enameled to resist rust, and they are sturdy and designed so they have small dust-collecting surfaces. Stock sizes include one 4 feet deep by 30 inches on centers, which makes a suitable unit for school work. Doors, if used, should be double-swinging pairs, without bolt or latch, and those with gravity hinges are less likely to get out of order. Doors should be shorter than the partition panels, and the bottoms should be 16 inches from the floor. Some school authorities leave doors off closet stalls altogether, and still others provide them for girls and not for boys, though there seems to be no good reason for the distinction.

Number of Fixtures. The economical number of fixtures to provide for any given condition has been worked out through months of investigation and timing under actual conditions of use. Even bearing in mind that it is customary to recess or dismiss many classes at the same time, the average use and re-use capacity of fixtures is very great, and the final rule is very close to the old 15 to 1 rule in force in many states and cities for factories, schools and similar buildings. This more complete rule is based on modern classes with from 35 to 40 pupils, evenly divided between the sexes, and calls for the schedule of fixtures for each such classroom served:

Boys' toilet room: ¾ water closet, 1¼ urinal, ¼ lavatory;

Girls' toilet: 1¼ water closet, ¼ lavatory, and ¼ drinking fountain in the corridor. If the school is for one sex only, or if the makeup of classes may be expected to differ continually, owing to some special local condition, it is a simple matter of figures to alter the rule to fit.

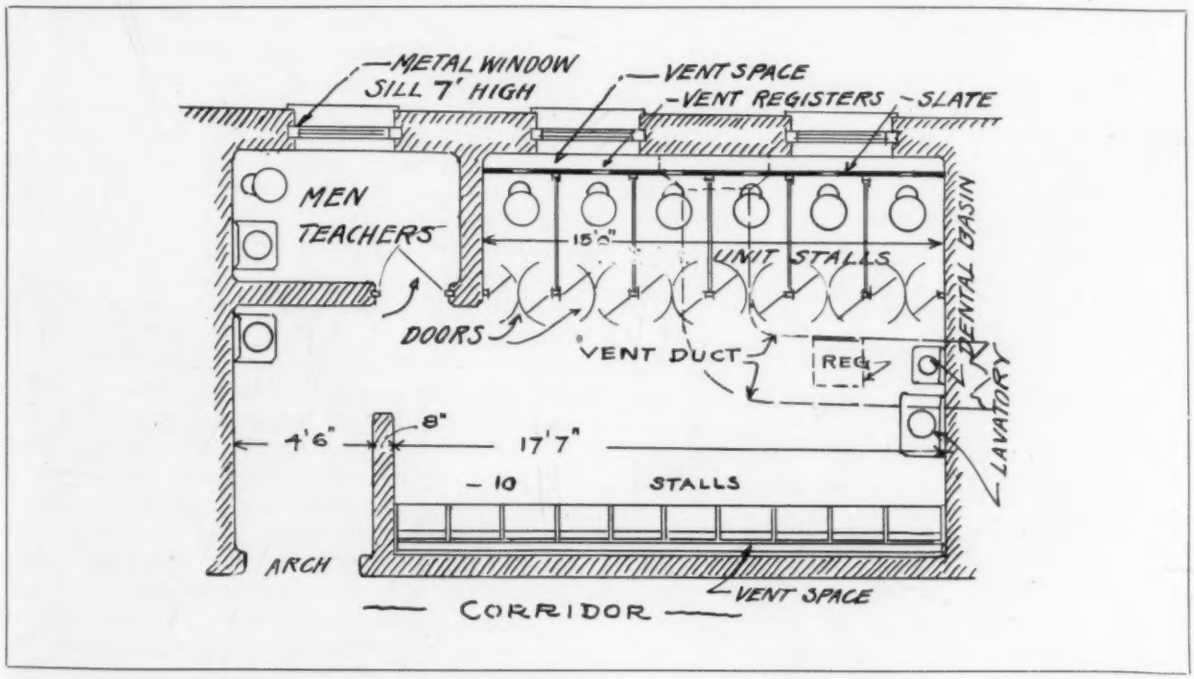
In following a fixture allowance rule, judgment

should be exercised when there are an odd number of classrooms to serve, but toilet rooms should be built to fit the fixture requirements and not a number of fixtures provided to fit a room of a set size. It is important that we have a sufficient number of fixtures for proper and reasonable use, but it is just as important that we have no more fixtures than are necessary. Every unnecessary fixture adds to the cost of the building, to the amount of space unavailable for other needed uses, to the water consumption, and to the repair expenses through the years to come. Fixtures, and especially valves and faucets, should be the very best that money can buy. The difference in first cost between a good fixture and a poor fixture is at most only two or three dollars, and the first of many repairs will cost that in plumber's time alone. The good fixture will rarely need repair, and the poor fixture will frequently need attention, and a fixture that is chronically out of order and not usable might just as well not be taking up space.

Water-closets should preferably be of the type automatically operated, as children, especially the younger ones, are exceedingly careless in the matter of flushing. Attached seats must be provided, as integral seats have been tried and found to have a generally unhealthful effect, due to cold flushing water passing through the flushing rim and chilling the body resting on it. One of the largest single items in plumbing repair bills for schools is for taking up and removing obstructions from closet bowls. This can be minimized by using a full siphon jet bowl with a 2½-inch or 2¾-inch waterway throughout, so that pencils, knives, cloths and dropped articles generally that will go into the bowl outlet will pass entirely through the trapway to the sewer without hindrance. In some cities the inspector is furnished with a wooden ball which he passes through each closet bowl before setting it, to be sure that the waterway is full size and is clear of obstructions.

There is some controversy over the proper height of the bowl, but good practice seems to point to the regular juvenile height of bowl for all grades. This bowl is 13½ inches from floor to rim and, with 1½ inches added for seat, it is only slightly lower than the average chair, and fits in with the claim often made by medical men that closet bowls should be lower than the usual standard height to provide a more natural and healthful position of the body during use. The seat should be of the comfortable saddle type, open at least in front. Ordinary wooden seats with either a varnish or celluloid finish have not proved very successful for school work, but there are several good composition seats with a minimum of unprotected metalwork to corrode. The solidity and strength of the hinge attachment should be carefully investigated, as well as the quality and fastening of the seat bumpers, the best of which must be replaced from time to time or the flushing rim of the bowl will be broken by slamming seats. Some bumpers cost three times as much as others and are worth it.

Flushing. The flushing should be full and powerful. Pressure flush is the only suitable system for school work, and it can be had in either of two ways, —by compression tank or by direct flush valves. Either type of valve will operate on 15 pounds pressure, but 30 to 40 is better and appears to be general. If direct flush valves are used, the diaphragm



Plan of a Typical Boys' Toilet Room

type which requires no adjustment and is easy to repair can be used to advantage. Such valves, however, require larger supply pipes than are customarily used with tanks, as all the water necessary for the operation of the valve must be furnished during the flushing period of about seven seconds, whereas a tank can be allowed 30 or more seconds to fill between flushes. If pipes are too small, the velocity of flow causes an annoying singing noise, and the valve frequently develops a "hammer" at closing.

Two elements enter into the water supply of fixtures, and in a sense they are independent of pressure, although uninformed people frequently attribute unsatisfactory operation simply to lack of pressure, not realizing that proper flushing depends on volume at the fixture and that just as much water can be delivered by a large pipe at low pressure as by a smaller pipe at high pressure. The two elements are volume and time, and the quantity of water which can be furnished at a given point within the period of the flush is called the "rate of flow." Assuming a five-gallon flush in seven seconds, this means a flow rate of about 40 gallons per minute for a valve closet, but if a pressure tank is used on the closet as a sort of accumulator to collect the five gallons for the short flush, it can be allowed 30 seconds or more to fill, at a flow rate of ten gallons per minute. Thus, other things being equal, any given size of pipe will furnish water for four times as many pressure tank closets as valve closets at the same rate of flow. To properly proportion closet supply mains, all factors should be taken into consideration, and sizes should be figured back toward the source of supply from each closet and each group; but this is too rarely done because of the computation necessary. It is, of course, impossible to be exact without taking into consideration elevation of fixtures, friction loss for length of pipe and the number and character of bends and valves, type of meter, and initial pressure at the source; but the table included here has been worked out as satisfactory with an assumed average for friction loss, an initial pressure of 40 pounds at the source, and a graduated overlapping flush allowance:

Number of flush valve closets allowed on various branch supply sizes

1 or	2	closets on	1¼″	pipe
	3	" "	1½″	"
4 to	6	" "	2″	"
7 to	12	" "	2½″	"
13 to	20	" "	3″	"
21 to	45	" "	4″	"
46 to	75	" "	5″	"
76 to	110	" "	6″	"

Number of pressure tank closets on other small fixture connections on various pipe sizes

1 to	2	connections on	¼″	pipe
3 to	4	" "	1″	"
5 to	8	" "	1¼″	"
9 to	12	" "	1½″	"
13 to	25	" "	2″	"
26 to	50	" "	2½″	"
51 to	80	" "	3″	"

In estimating for urinals with flush valves, two urinals should be figured same as one water closet valve in the first table.

Urinals. There are two types of fixtures most suitable for schoolhouse use,—the vitreous china (not porcelain) stall urinal, and the slate stall type. In either case they should be set down into the floor construction so that the immediately adjacent floor surface grades into a waste trough part. The slate type should be used only where water is plentiful and where a continuous film of flowing water from the overflow flushing troughs can be maintained or an automatic periodic flushing device is used. The vitreous individual stall type should be flushed by a foot-operated flush valve set in the floor. The standard 18-inch width vitreous stall gives really too little shoulder room, even for children, if placed in battery, but if they were made in the 24-inch width, the same as biscuit porcelain, that would give more shoulder room than necessary. The medium of 21 inches on centers seems to be best for all purposes, giving sufficient but no excess shoulder room, economy of space and of cost. The 18-inch stalls as now made must be set 3 inches apart, with a dirt-collecting space, or the spaces must be blocked out, plastered and tiled, thus adding to the expense. Tiling these spaces makes them more sanitary than leaving them open, but not as sanitary as a vitreous unit 21 inches wide would be with its single joint. The slate stall fixture can be obtained in any of the three widths, and is a continuous fixture of practically non-absorbent material. It seems hardly necessary to mention the obsolete enameled iron trough urinal or slate slabs flushed by a perforated pipe. These are, of course, much cheaper than stall unit work, but a saving of money at the expense of sanitary conditions should never be considered.

Floor drains should never be installed in school toilet rooms unless they are provided with a full size vent and have a flushing rim automatically flushed from a tank on the wall two or three times a day. Without this flushing, they are catchalls for sweepings, and the water seal is rarely replenished and evaporates in a month or so, permitting direct entry of sewer air into the toilet rooms.

Lavatories or wash basins should be of substantial pattern with as small a slab size as can be used with an adequate bowl. A small slab has little space for dust collection and offers less inducement to tired boys as a resting place. The fixture should be supported on a leg or legs and have more than ordinarily strong fastenings to the wall, such as 4-inch expansion bolts or lag screws and lead sleeves. Extra-heavy, self-closing basin faucets should be used, so that water cannot be left running by careless pupils. The use of "pop-ups" and other such wastes should be avoided, as they are a constant challenge to the small boy with mechanical ideas. A plug and chain are all that are necessary, and the school authorities should make up their minds in advance that the chain will have to be replaced within a week after opening.

and that rubber plugs of the cheapest kind must be bought by the gross. They are, however, much cheaper than constant repairs and replacements to mechanical wastes.

The cleanest and really the proper way to wash hands is in running water, leaving a free opening to basin waste, but that cannot be done now with the self-closing faucets we have to select from, as all of the practical faucets are quick-closing, and we cannot use a compression faucet without risking much water waste, expenditure of coal or gas in heating water, and danger of splashing or overflow of fixtures. It is quite possible that some of the present slow-closing valves will be perfected to a point where they will be reliable for use on school basins. Dental lavatories are a distinct step in advance, and their provision in schools might teach pupils of an impressionable age that the lavatory is hardly the proper place to spew mouthwashings.

Drinking Fountains. Drinking fountains are of many kinds. The "bubble fountain" has taken the place of the old oaken bucket and the rusty dipper, and there are ring spray-bubblers, vertical- and diagonal-stream bubblers, and single-, double- and multiple-jet patterns. The diagonal-stream devices seem to appeal to one as less liable to contamination, and of this type perhaps one of the best known is the double-jet arrangement where two small jets meet to form a mound for drinking. This device was developed during the war for use in France, where water waste was of moment, and many thousands of the fountains were in satisfactory use there and in the training camps in this country. Water for drinking purposes will generally be found cool enough without refrigeration, unless the mains are laid shallow in warm climates, where the water comes from warmed tanks, or where for some other reason the temperature is higher than it would be from wells or from properly laid mains. Drinking water of icy temperature is unhealthful, and for ordinary drinking purposes it should not be colder than 45 or 50 degrees. This subject has been given much study by mill and factory medical men, and proper control of drinking water temperature is reported as greatly reducing layoffs on account of stomach troubles induced by drinking very cold water when in a heated condition. The same considerations apply to children drinking after a strenuous play period. If it is found advisable to cool the water, it should be done by a central refrigerating plant, controlled by a thermostat, instead of by introducing ice into the water.

One difficulty with diagonal-stream fountains is their response to variations in pressure by changing the height of the stream every time pressure is lowered in the lines by flushing several fixtures. This can be avoided by passing all drinking fountain supply through a water pressure regulator and reducing the supply to them to a point where variations will not drop below the setting of the regulator. In connection with the pressure-reducing valve, a sand trap is often installed to screen out any foreign matter in the water.

Hot water should be supplied to all lavatories, together with liquid or powdered soap and paper towels, as children will not wash in discomfort or without soap and means of drying. The hot water supply should be of the instantaneous type, or the equipment should provide large storage capacity with a comparatively small heater, as the total use is spread over about four hours out of the 24 and nearly all during some three or four 15-minute periods. A circulating return will tend to save much water, though it will require more coal or gas to operate. In case special kindergarten toilets are wanted, siphon-jet infant-size closet bowls can be had with heights of 8½ or 9 inches, and lavatories can be set 2 feet from the floor instead of at the regular height.

Fire Protection. Fire standpipes, although used extensively in school buildings, are rarely considered a necessity. In some localities rates may make their installation desirable financially, but generally all modern school buildings are fireproof up to the ceiling lines of the top floors, and a judicious distribution of extinguishers, taking care that they are periodically charged, will take care of any minor fire until the arrival of fire apparatus. Teachers should not be charged with fire fighting or anything that will take their minds from their most important duty, that of getting the children out. In case the building is in a country town with little or no fire department and without a pressure water supply, several hydrants in the school grounds attached to the school water system are much to be preferred to interior standpipes. These hydrants should be 50 or more feet from the walls of the building, so that fire heat may not prevent servicing them, and the hose should be kept in an outbuilding. If the school has an auditorium with stage space for scenery, an automatic sprinkler system should be provided beneath and over the stage, in all dressing rooms, and in all stage property storage rooms. It is good practice to have the asbestos fire curtain operate on a "trigger connection," so that if there is a lack of pressure the curtain cannot be raised for a performance, and if the pressure drops dangerously low, the curtain will come down of its own accord.

Piping. The plumbing piping system should be of the best. The materials and workmanship should be such that the plumbing installation will last for the reasonably-to-be-expected life of the building. This does not mean the entire structural life but until the condition of the entire building and plant is such that it becomes necessary to remodel. It is safe to say that this period will be at least 30 years and may be 50. Therefore, care should be taken not to bury in floor or wall construction any material of shorter life, and to see that all valves or other parts requiring repair or replacement are left, together with their connections, in accessible positions. It pays to use a heavier grade of fittings of galvanized iron or brass pipe than would ordinarily be specified,

and to have all waste and soil pipe fittings of the long radius pattern to avoid the possibility of obstructions' building up. Probably extra-heavy cast iron soil pipe will have longer life than galvanized iron pipe. Some engineers prefer genuine galvanized wrought iron in place of the soft steel pipes of commercial grades. Brass pipe answers the need for long life water pipe where it is concealed, but galvanized iron, of a larger size to take care of inside corrosion, may last if it is painted and given a protective wrapping. Pure copper tubing is used to some extent, is much cheaper than iron pipe gauge brass pipe, and it is flexible and easily worked.

All water piping, whether concealed or exposed, should be covered with asbestos or hair felt covering. This protects the pipe from corrosion through contact with building materials such as mortars and concrete, minimizes loss of heat in hot water piping, and prevents condensation on the cold water lines. It also prevents, to some extent, noises due to pipe vibrations, though it is good practice to install shock absorbers at strategic points to take care of water hammer if it does develop. Each main water line in the basement should be painted its distinctive color, and all valves should be tagged. The plumbing system should be adequately vented, the fixture wastes having individual vents or being connected on a circuit or loop vent in accordance with modern practice. If the state, city or town has no plumbing code, the "Hoover Code*" requirements should be strictly adhered to.

Special Pipe. Wastes from chemical and physical laboratory sinks should never be connected to the general plumbing system of the building, and they should be run exposed for easy inspection and repair unless the waste lines are constructed of pipe proof against the commonly used acids. Special pipe for acid work can be had in several materials, such as a composition of hard rubber, stoneware, china, lead-lined iron, and cast iron with a high silicon content. They are all hard to work, and the fittings of some are cumbersome, but the silicon iron, being so similar to the cast iron soil pipe used elsewhere in the system, probably will be most satisfactory. In using this, or any acid-resisting pipe, joints are weak points, and special asbestos jointing material must be used.

Valves. Too much stress cannot be laid on quality of valves. They vary widely in price, but the best will be found much cheaper in the end. Globe valves should be used sparingly on account of their resistance to flow which is about 20 times as much as for the same size gate valve under equal conditions of pressure and rate of flow. It is best to select the make of valve to be used and have the same make throughout the work. All valves in rooms to which pupils have access should be of the lock shield, removable handle type, which cannot be meddled with.

Pumps and Tanks. If a pressure water supply is not available, then a pumping system and an elevated tank may be used, but as satisfactory operation of valve closets depends on a head of 35 or 40 feet above the topmost fixtures, a pressure tank layout will be found more serviceable and less costly. A proper size tank would hold not less than 400 gallons per classroom in combined air and water. The tank (or tanks) may be heavily coated with protective paint and buried in the ground with just the head and connections exposed in the basement. Gauge glasses as well as pressure gauges should be provided, and a dependable relief valve is a necessity whether there is one on the pump or not. Good practice is to have a separate air pump instead of relying on the snifter valve usually furnished on the water pump, as it places better control in the hands of the operator. Automatic intakes on pumps are almost always furnishing either too much or too little air, and trouble with the system results either way. Unfortunately, centrifugal pumps cannot always be used on wells and pump heads, and jacks are noisy and the monotony of their pound has a bad effect on school work. If deep well work is necessary, an air lift system will be found best, although more expensive.

Sewage Disposal. In the absence of a public sewer system, a sewage-disposal plant is a necessity. A leeching cesspool is an abomination and should never be considered, even if the law is loose enough to permit it. What is usually called a septic tank will answer for the preliminary treatment of reducing the sewage to a liquid form, but even in the design of this there is the difficulty that the quantity of sewage to be treated varies greatly. The plant must normally work five days and be idle two, and there are several short and one long vacation, and stale sewage will not respond readily to secondary or purifying treatment. This intermittent use also tends to sludge up the tanks excessively, but as the tank must be desludged each fall anyway, this condition only adds to the size.

A two-or three-part concrete tank of rectangular shape is generally used, although a much smaller unit built on the Imhof principle will occupy less space and possibly will cost less to build. The Imhof pattern has the advantage of quickly clearing of stale sewage on occasion, the mat area is small, and removal of sludge is easier.

*The so-called "Hoover Code" is published by the U. S. Department of Commerce under the title of "Recommended Minimum Requirements for Plumbing in Dwellings and Similar Buildings." It can be obtained from the Superintendent of Documents, Government Printing Office, Washington, for 35 cents, cash or money order; checks or stamps are not acceptable.

SCHOOL FINANCING AND THE ARCHITECT

BY

C. STANLEY TAYLOR

AT first thought it might seem that the architect would have no particular interest in the question of financing school building projects.

The reason that the architect's relation to the financing of school buildings is becoming of paramount importance is because the nature of such financing invariably establishes an almost absolute cost limit or budget for the building operation. It is quite unnecessary to go into details regarding the types of school bonds or the methods of taxation. The important point for the architect to consider is that a bond issue, a special tax, or an endowment, prescribes a definite sum of money which should not be exceeded by the cost of the land, building and equipment. Last year an extensive survey was made by the Better Schools League, Inc., of Chicago. So many valuable facts were developed in the course of this survey that it is drawn upon freely in the development of this article.

Costs and Appropriations. The Better Schools League survey brought out some very interesting information in relation to the question of construction and equipment costs' exceeding bond issues or appropriated funds. In 350 cities which erected school buildings within the past five years, 22 per cent of them over-spent the bond issues or appropriations. The results of incurring building and equipment costs which exceed appropriations are always unfortunate, and in many cases the architect is directly charged with the responsibility. In the first place, if there is an excess cost, the community is forced to issue warrants bearing high rates of interest. In many communities this practice is not legal, and the only thing that can be done where the construction cost is excessive is to curtail definitely the finishing and equipping of the building. Old equipment may be substituted for new, and in every way the final structure will be inferior, according to present-day standards. This situation may also lead to instructing important extra-curricular activities,—music, art, industrial arts, gymnasium and playground activities. Under these conditions also it becomes impossible to develop the school as a community center and to provide the various facilities necessary to contribute to community life. It becomes quite evident, then, that the architect's relation to financing has much to do with developing a building which will unquestionably come within the construction budget. The fact is, however, that this relationship should logically begin at the earliest stage, when the project of a new school building is first contemplated and before any bond issue or appropriation is established. An architect should be called upon at this stage to investigate the school requirements and with rough preliminary plans to indicate to city officials or the school board how much money is really necessary for the building and its equipment.

The Fixed Budget. This question of developing plans within fixed budget limitations offers in itself a series of problems which must be solved in a practical manner by the architect. The first temptation, of course, is to establish construction and equipment cost savings through the use of less expensive materials, and perhaps through simplified planning. This is a logical way to bring down the cost of a building of any kind, but at the same time it is a very dangerous procedure unless practical minimum standards are set. It must be remembered that school buildings are built to serve the community for a great many years and in the most efficient possible manner.

The information which follows is presented primarily as a guide to the architect who undertakes school work. It gives some very definite information as to the cost of the construction of schools of various kinds and also shows at least one recommended method of establishing the related budget of equipment cost as compared with the total building cost. The data have been taken from last year's survey by the Better Schools League, Inc.

Ratios of Building to Equipment Costs. General experience with the school equipment budget indicates that it should be established as an entirely separate fund upon which the building cost itself should not encroach. Reports received by the Better Schools League from 350 cities which have erected school buildings since the year 1923 showed a very consistent ratio of the percentage of the bond issue which should go into the building proper and that which should go into equipment. The experience of this group provides a basic standard of average practice. The summary for the different types of school buildings is indicated here. It may be noted that school buildings throughout are classified according to the grades housed in the structures. Thus, grades 1 to 8 represent the average elementary school; grades 1 to 9 represent elementary and junior high school combined; grades 1 to 12 represent elementary and high school combined; 7 to 9 junior high school; 7 to 12 junior and senior high school; 9 to 12 regular high school; and 10 to 12 senior high school. The term "upper 50 per cent" is also used, indicating the finer standards of modern construction and equipment, so that the general figures given represent average practice, but those labeled "upper 50 per cent" represent the practice of the better-than-average group.

According to analyses in 350 cities, in school buildings housing grades 1 to 6, the average equipment cost was 8.2 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of bond issue

going into equipment, was 11.2 per cent. In school buildings housing grades 1 to 8 the equipment cost was 10 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of bond issue going into equipment, was 13.7 per cent.

In school buildings housing grades 1 to 9 (elementary and junior high school combined) the equipment cost was 13.6 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of bond issue going into equipment, was 19.2 per cent. In school structures housing grades 1 to 12 the equipment cost was 14 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of the bond issue going into equipment, was 18.3 per cent. In buildings housing grades 7 to 9 (junior high school) the equipment cost was 10 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of the bond issue going into equipment, was 12.5 per cent. In school buildings housing grades 7 to 12 (junior and senior high schools combined) the equipment cost was 12.2 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of the bond issue going into equipment, was 18.5 per cent. In buildings housing grades 10 to 12 (senior high school) the equipment cost was 16.6 per cent of the bond issue or appropriated funds. The average of the upper 50 per cent, classified on the basis of per cent of the bond issue going into equipment, was 22.6 per cent.

On the basis of these averages, a table of budgeting,—assuming the building and equipment cost $300,000.00,—would be:

Budget for School Building and Equipment

To House		Cost of Equipment	Cost of Building
Grades	1-6	$24,600	$275,400
"	1-8	30,000	270,000
"	1-9	40,800	259,200
"	1-12	42,000	258,000
"	7-9	30,000	270,000
"	7-12	36,600	263,400
"	9-12	45,000	255,000
"	10-12	49,800	250,200

It is manifestly difficult to lay down a definite and established ratio between the cost of the building and the cost of equipment. The average for the junior high school is low in comparison with others, possibly because it is a new institution, and its needs therefore, not so well standardized. The averages given here show the general trend and afford local school officials an opportunity to check their own school costs against the general averages.

For those who are interested in knowing what the "upper 50 per cent" or better than average groups are doing, this table indicates the allocation of the total budget for a school building project,—assuming again the cost of building and equipment to be $300,000.

AVERAGES FOR "UPPER 50 PER CENT"

Budget for School Building and Equipment

To House		Cost of Equipment	Cost of Building
Grades	1-6	$33,600	$266,400
"	1-8	41,100	258,900
"	1-9	57,600	242,400
"	1-12	54,900	245,100
"	7-9	37,500	262,500
"	7-12	47,100	252,900
"	9-12	55,500	244,500
"	10-12	67,800	232,200

Survey of Actual Costs. Returning again to the question of school building costs, the most reliable data was received by the Better Schools League, Inc., 53 West Jackson Boulevard, Chicago, in the course of their extensive cost investigation. In this survey will be found a detailed list of actual school building projects, giving in all cases the essential data, including cost per pupil and in many cases the actual cost per cubic foot. Of the various buildings on which costs are given, 228 are of fire-resistive construction; 94 are of the slow-burning type of construction; and 5 have practically no structural safeguards against fire. The tabulations give in the first column the type of school described by grades housed in the structure. The meaning of these various grades has already been presented in preceding paragraphs. The second column gives the year of construction; the third gives the maximum pupil capacity; the fourth gives the cost per pupil; and the fifth gives the cubic foot cost in cases where costs are available. These figures are conveniently divided into various states. They will unquestionably serve as a general basis for comparative cost estimating. It must be realized, of course, that cubic foot cost data have definite variations and limitations, and that the same structure in one locality may cost more or less than in another. The building that costs $300 per pupil may provide twice as much in the way of facilities of an auditorium, gymnasium, laboratories, etc., as the structure costing $150 per pupil, so that it is not safe to assume that the school built at lower cost is necessarily the most efficiently designed. The opposite may be the case.

EDITOR'S NOTE—The full tabulation of school building costs, arranged according to the type of school, the year constructed, the pupil capacity, the cost per pupil and the cost per cubic foot, is published in a booklet entitled, "School Construction Costs and Equipment Budget." This booklet, which is described by Mr. Taylor, is published by The Better Schools League, Inc., 53 West Jackson Boulevard, Chicago, and is the result of an investigation which covered reports from 350 cities which have erected school buildings within the past five years.

COSTS AND CONSTRUCTION

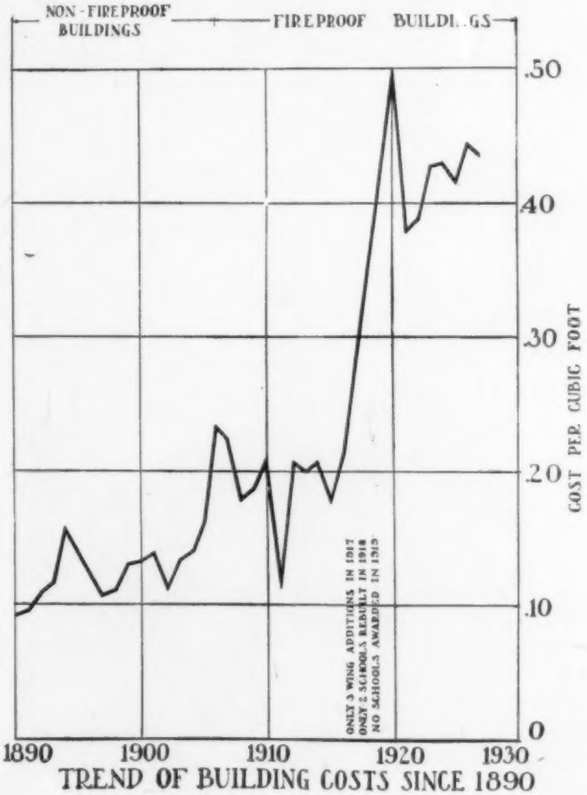
BY
IRWIN T. CATHERINE
ARCHITECT, SCHOOL DISTRICT OF PHILADELPHIA

DURING the year 1905 and subsequent years, school buildings, when finances made it possible, have been constructed of fire-resisting materials, using the wall-bearing type of construction, which in more recent years has made way for the column-bearing type,—a more economical and practical form of construction. This change in design has been greatly augmented by the great number of school buildings that have been destroyed by fire. Statistics show, even in this modern age when everything is being done to preserve human life, that a great number of school buildings of all sizes throughout the country are still being constructed of non-fire-resisting materials and that on every day in the year, approximately five such buildings are burned to the ground. This is not confined to buildings erected during the early part of our educational development, but includes some constructed during recent years. The desire to reduce fire losses to the minimum, together with new standards of higher education and laws enacted by the legislatures of the different states, has resulted in the development of the modern school building.

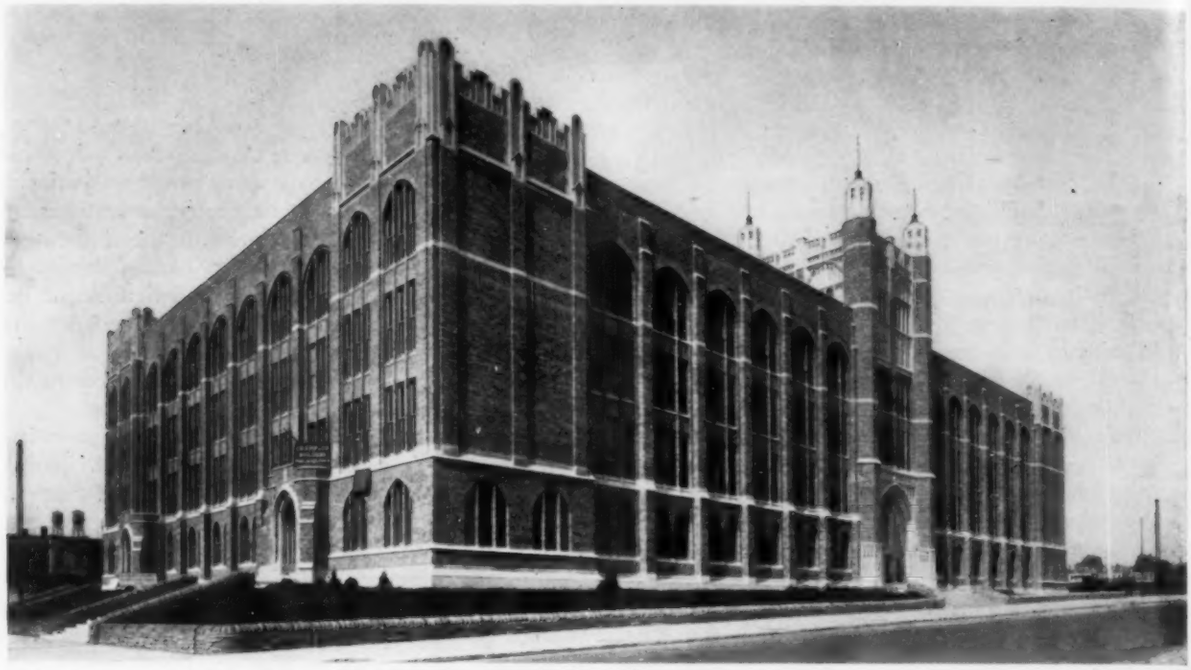
Costs. Some elementary schools completed during the latter part of 1927 in one of the large cities at a cost of approximately $543,000 each were designed of concrete with full column-bearing type construction and had in general 35 class units, including shops, recreation rooms, auditoriums, doctors' rooms and boys' and girls' interior toilets on each floor. Buildings are now completed in their entirety within 12 months from dates of awards, which would not have been possible had wall-bearing construction been used. A senior high school completed during the early part of 1927 at a cost of $2,170,191 of construction similar to that of the elementary schools, included over 100 class units, among which were units for the study of chemistry, physics, art, mechanical drawing, home economics, physical training, manual training, music, botany and others too numerous to mention. Within this building are also to be found a large auditorium, up-to-date administrative offices, toilets and rest rooms.

The constant change in ideas for the educational requirements of the child, together with new building laws, has kept the designers of school buildings on the alert in order to keep pace with the latest developments. As a result, many new details have been introduced in construction and design that would not otherwise have occurred. It is interesting to note the mounting cost per cubic foot of buildings of this class from 1890 to date, as indicated on the diagrammatic chart shown on this page. The rising prices can be attributed to increased cost of labor and materials and to the greater amount of materials being added to each cubic foot of space as the educational system develops, with a simultaneous elaboration and beautification of the exteriors of the buildings. Much study has been given to every part of the building in order that the cost of installation might be reduced to a minimum consistent with good design.

Economy of Space. There has been a great advance in what is known as concrete column construction, using spandrel beams to support exterior and interior walls. This type of construction provides saving in space, economy in construction and rigidity and rapidity of erection over the former wall-bearing type. The skeleton-frame type of construction allows a reduction in the gross area as well as the total height of building. This is very evident by referring to the illustration of "Comparative Types" which shows three systems of concrete construction. In the use of 13-inch curtain walls and 4-inch tile partitions one can readily visualize the saving in total area, which is often as much as 3 per cent. By reason of the shallow floor construction and the omission of the large factory-like windows sometimes placed in school buildings, about 5 or 6 feet may be saved in the total height of a three-story building, which may permit a total reduction in the cubage of the building of approximately 10 per cent.



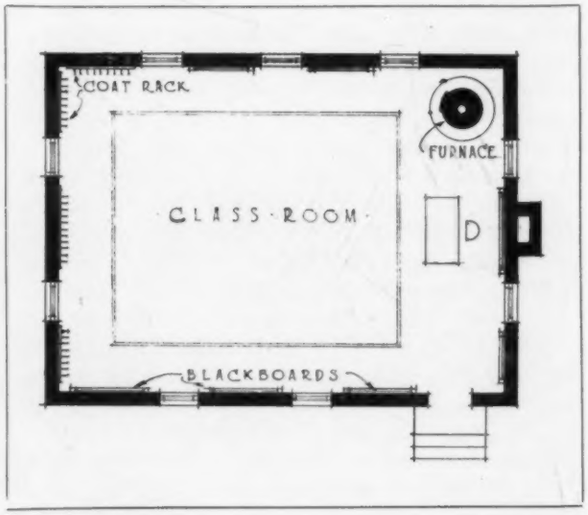
TREND OF BUILDING COSTS SINCE 1890



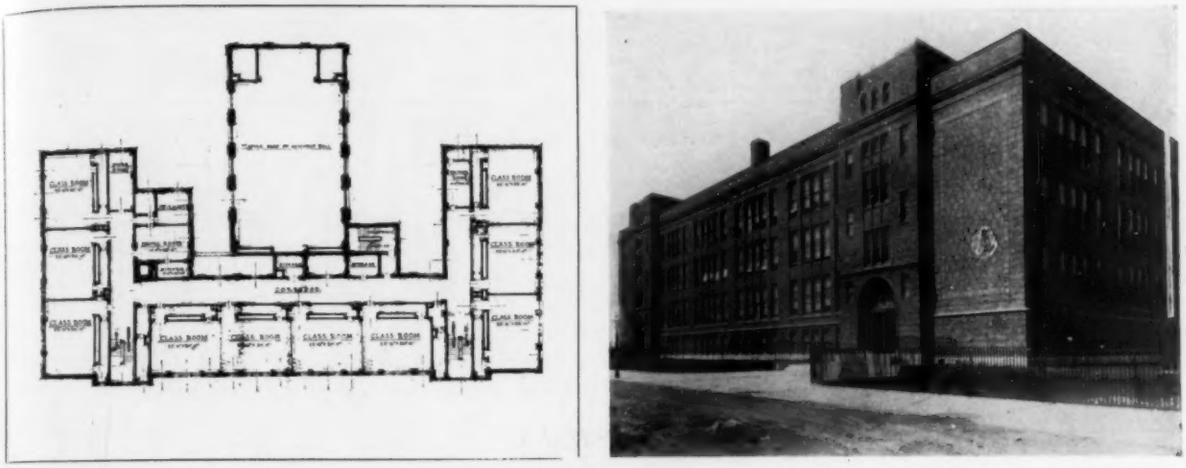
Typical Junior High School, Completed 1927. Cost Per Cubic Foot, 43 Cents. Cost Per Pupil, $608. Pupil Capacity, 2040

This reduction in cubage, however, is not so evident in the cost per cubic foot as in the total cost of the building and the cost per pupil. This theory is proved by the example of a school recently constructed without an auditorium, where the per cubic foot cost was 42 cents, with the per-pupil cost as low as $253. Here the plan was rectangular and had no waste areas. On the other hand, in another building, having an auditorium, the cubic foot cost was 43 cents, while the cost per pupil was $345. Thus, while the increase in the per-cubic-foot cost due to the inclusion of the auditorium is but 2½ per cent, the increase per-pupil cost is more than 36 per cent.

Rapidity of Construction. Rapidity in construction is an important factor in the building of schools, and this is best accomplished when all trades can proceed independently of one another and without interference of any kind. This is better accomplished with the skeleton form of construction than with the wall-bearing, for the reason that floor after floor can proceed without waiting for bricklayers and other sub-contractors to get on the site. The solid concrete floors and stairs become a protection to workmen against weather and accidents, and facilitate the movement of materials and labor as soon as this portion of the work is completed. School buildings with a cubage of over 1,000,000 cubic feet have been completed and fully equipped within a period of from nine to ten months after the work was started. The rapidity of construction resulting from the use of this type is closely allied with economy in construction, so that owner and contractor are always



A One-Room School Building of 1820



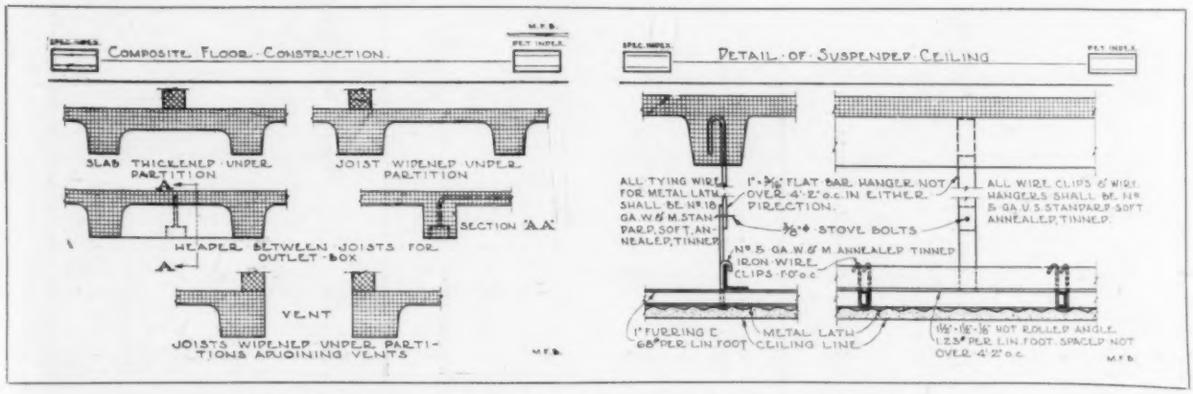
Typical Elementary School, Completed 1927

the principal beneficiaries, as indeed they should be.

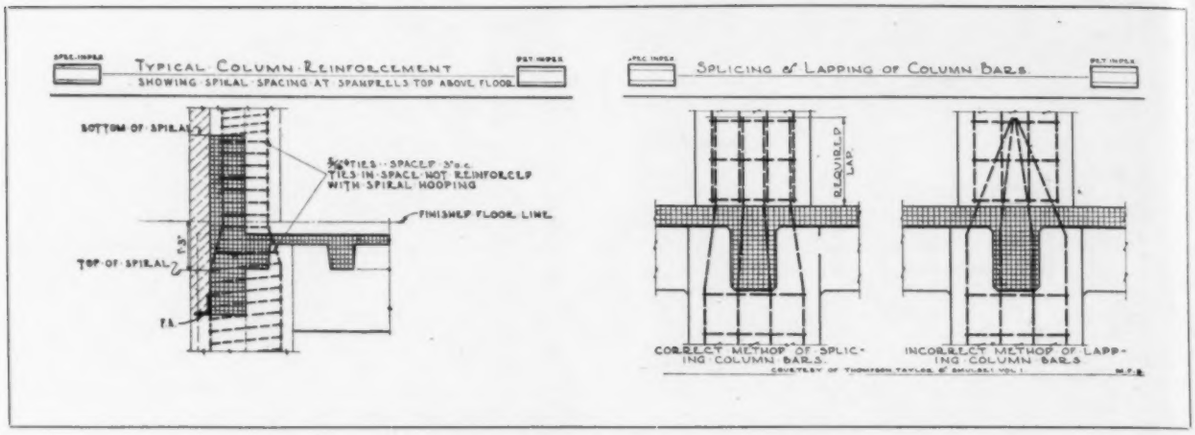
Rigidity of Construction. One of the most important qualities in the use of concrete is the rigidity that is secured by the skeleton type of construction. It is very important that the vibrations caused by children marching or drilling should not be transmitted to the classrooms, and that the noise and motion of the gymnasium should not in any way disturb the auditorium exercises. The rigidity of the concrete skeleton frame building gives assurance and satisfaction in a heavy wind storm such as have been experienced recently in many parts of the country. In connection with these wind storms, it will be noticed that wherever loss of life has occurred from a collapse, the building was of the wall-bearing type.

Economy of Construction. Since the adoption of the full skeleton type of construction, many buildings have been erected of the reinforced concrete skeleton type. Using this, it has been possible to complete and fully equip $500,000 buildings in ten months, when it once took twice that time. Study and research have made it possible to standardize certain drawings and details, with the result that within 24 hours after a contract is awarded practically 80 per cent of the details required for the building can be issued to contractors. In this way there is no wasteful and expensive delay, and the contractor is able to reduce his own overhead charges.

Details of Construction. The details of construction here shown may be considered typical for this kind of building. In general, classrooms are 30 feet long in the clear, so that the spacing of columns is 15 feet, 2 inches. The floor and roof construction is formed of 5¾-inch wide concrete joists (usually 8½ inches deep), 26 inches on centers, with slabs 2½ inches thick. This floor, known as "composite" construction, is framed to a large girder 16 inches wide by 26 inches deep, having a span of 23 feet, with a wide tee, which runs from column to column across the width of the room (Diagram page 474). The slabs and joists, in the schools just mentioned, are "formed up" by the use of No. 12 gauge removable steel forms, which may be removed two to four days after the concrete is placed, providing the supports under the joists are left in place. This permits the continuous use of the forms, so that a comparatively small quantity will be sufficient for the entire building. There are various other satisfactory types of concrete floor construction, such as terra cotta or light hollow concrete blocks spaced so as to form the rib beams, flat slab construction reinforced in various ways, etc. The finished ceilings of the classrooms, corridors, and other rooms are formed by expanded metal lath suspended beneath the soffits


COMPOSITE FLOOR CONSTRUCTION
SLAB THICKENED UNDER PARTITION
JOIST WIDENED UNDER PARTITION
SECTION 'AA'
HEADER BETWEEN JOISTS FOR OUTLET BOX
VENT
JOISTS WIDENED UNDER PARTITIONS ADJOINING VENTS
DETAIL OF SUSPENDED CEILING
ALL TYING WIRE FOR METAL LATH SHALL BE No 18 GA W & M STANDARD SOFT ANNEALED TINNED
1" x ⅜" FLAT BAR HANGER NOT OVER 4'-2" o.c. IN EITHER DIRECTION.
⅜" ϕ STOVE BOLTS
No 5 GA W & M ANNEALED TINNED IRON WIRE CLIPS 1'-0" o.c.
ALL WIRE CLIPS & WIRE HANGERS SHALL BE No 5 GA U.S. STANDARD SOFT ANNEALED TINNED
1" FURRING @ 68# PER LIN FOOT
METAL LATH CEILING LINE
1½" x ⅛" x ⅛" HOT ROLLED ANGLE @ 2.5# PER LIN FOOT SPACED NOT OVER 4'-2" o.c.

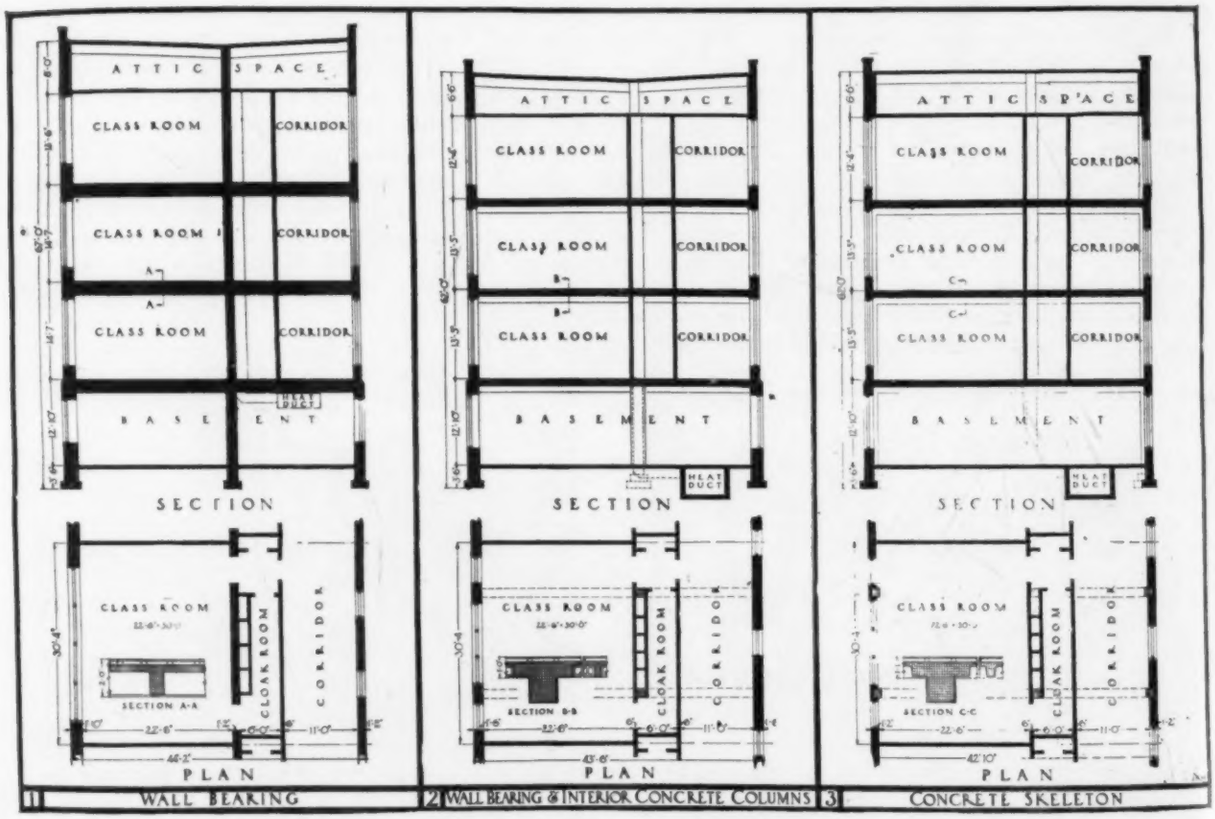
Typical Details of Construction Used in Connection with the Specifications


TYPICAL COLUMN REINFORCEMENT
SHOWING SPIRAL SPACING AT SPANDRELS TOP ABOVE FLOOR
BOTTOM OF SPIRAL
TOP OF SPIRAL
FINISHED FLOOR LINE
SPLICING & LAPPING OF COLUMN BARS
REQUIRED LAP
CORRECT METHOD OF SPLICING COLUMN BARS
INCORRECT METHOD OF LAPPING COLUMN BARS

Typical Details of Construction as Issued by the School Architect

of these joists and plastered with the usual three-coat work. The ceilings of the upper stories are formed in a similar manner, supported on channels or angles which are suspended several feet below the roof construction. The space between the roof and the ceiling below is useful for the steam pipes and ventilating ducts which are so necessary in large school buildings. (See illustration "Comparative Types," below.) All exterior walls are of face-brick veneer with a backing of a hollow tile or common brick supported at each floor on concrete spandrel beams, which are framed monolithically with the floor, girder and column construction. An important feature of the construction is the all-concrete stairways which are poured with the floor construction, providing safe and easy access to all floors.

It is almost impossible to imagine what changes will occur in school buildings which may be erected during the next 100 years, considering the great changes that have developed during the past hundred. Will they be huge structures, three and four times the sizes of the present buildings, or will education, like all other enterprises and developments, reach a "saturation" point? The writer believes that there will come a time when the mechanical activities will be removed to special trade schools, and that the new education in these buildings will revert to that of the "three R's" of a more advanced standard.



Comparative Types of Construction

SPECIFICATIONS FOR THE SCHOOL BUILDING

BY
CHARLES E. KRAHMER
OF THE OFFICE OF GUILBERT & BETELLE, ARCHITECTS

THE "Tentative Contract Forms" submitted by the Interdepartmental Board of Contracts and Adjustment of the Bureau of the Budget, U. S. Government, contains this excellent definition of public and private contracts:

"1. All public contracts are made by agents with limited authority. Their authority is governed and controlled by the laws under which they are authorized to act.

"2. It is a well established public policy that all public contracts shall be let after open and free competition to the lowest responsible bidder, and that, in order to accomplish this result and have competition based on uniform terms, the government, states, counties and municipalities must dictate the terms and conditions that must be met by the bidder.

"3. In order to carry out this public policy it is necessary that the contracts shall be carried out and performed in substantial compliance with the terms and conditions under which they are let. No officer of the government, or of a state, county or municipality, has the right to vary the terms or waive the rights accruing under such contract. In private business, however, the individual awarding the contract can do what he pleases with his own money or his own property, and he can select his own contractor upon his own terms. He is free to order any changes he may desire to have made in the contract and to make any kind of settlement he can arrange with the contractor after performance has been completed."

A contract for a public school is a public contract, subject to the restrictions quoted. There are some municipalities and school districts where a public school contract may be legally handled as a private contract. In these cases it is generally considered for the best interests of the public to handle them essentially as described for public contracts.

A close contact with public contracts over a period of years reveals the fact that the element of "good will" is absent in this class of work, and there appears to be a good reason for this condition of affairs. "The lowest responsible bidder" is an elastic term, which includes generally all not in receivership or jail. This state of affairs is due largely to the surety companies, which seem willing to furnish bonds to anyone able to pay their fees. When a surety company guarantees the responsibility of the contractor, the school board is in effect denied the right to judgment which the law intended. A public contract is awarded as the result of a "free for all" upon a strictly price basis, and the successful bidder generally feels that the contract was awarded without regard to ability, character, integrity or financial responsibility, and, therefore, he is entitled to take advantage of all of the "breaks," errors, misinterpretations and omissions, and will create as many of these to further his own interests as possible. The specification writer should be thoroughly familiar with the effect of public bidding and the lack of "good will," and he should erect a defense against the evils resulting from open bidding and the lack of "good will." In order to effectively carry out the policy and conditions defined for public contracts, it is necessary to include in the specifications requirements and conditions peculiar to this class of work. An attempt has been made in this article to restrict the discussion to those questions which require special treatment in public contracts, and no attempt will be made to cover questions which are encountered in specifications for the average work.

Advertisement: The advertisement is generally included as part of the contract documents and should, therefore, be prepared by the architect. The advertisement is the concrete expression of "open bidding" and is rquired to insure such bidding. Certain municipalities and school districts have requirements which differ from others, and the specification writer should consult the secretary of the school board before preparing it. The advertisement should state briefly when and where the bids will be received, the character and size of the project, the number of contracts, the deposit required to guarantee the bid, and whether it will be a certified check, bid bond or cash; also where plans can be obtained for estimating purposes and the deposit required for them. The advertisement should be included as part of the specifications and a copy turned over to the secretary of the school board for insertion in the papers. When this detail is handled by the architect, he should look up the law, as it varies not only in different states, but also in different municipalities and school districts.

Proposal Form. In order to carry out the policy of dictating all of the requirements and conditions that must be met by the bidder, and to insure the bids being received on exactly the same basis, the proposal form is always included. The proposed form should be prepared by the specification writer and is either included in the specifications or as a loose form with the specifications. The proposal form simplifies the public reading of bids and becomes part and parcel of the contract documents. The proposal form should be made out in complete detail, so that it will only be necessary for the bidder to fill in the amounts and sign it. When alternative estimates and separate estimates are required, the exact wording of each should be on the proposal form, so that it will be necessary to fill in only the amount. The courts have ruled that optional alternative bids which deal with a system or method

different than that specified are illegal, due to the fact that the other bidders did not have the opportunity to estimate upon the same basis. For this reason proposal forms which request the bidder to name the time of completion have been held illegal because all bids were not on the same basis.

Deposit Guaranteeing the Bid. In order to prevent fraud in public work, a deposit is required with the bid guaranteeing that the bidder will execute the contract if it is awarded to him. The deposit may be cash, certified check or bid bond, and the amount required will generally vary from 2 to 10 per cent of the amount of the bid, depending upon the amount of money involved. A bid bond is furnished by a surety company for a nominal fee as an accommodation, and as such they expect to receive the contract surety bond if the bidder be awarded the contract. Some school boards will not approve some surety companies, and in order to prevent the necessity of disapproving a surety company after it has guaranteed the bid of a successful bidder, they refuse to accept bid bonds as deposits and demand certified checks or cash. To prevent issuing certified checks upon weak banks, some school boards require that the certified check be made upon a member bank of the Federal Reserve System, as a bank must qualify before being accepted as a member. It is usual to require all bids to hold good for 30 days after their receipt, and to require the retaining of the deposits of the three low bidders on each class of work until the contract is executed. As the deposit is frequently 5 per cent of the bid, this means that this amount is deposited without interest with the school board for this period of time. Some school boards do not request funds for building purposes from the public or board of school estimate until the bids are received, and it is manifestly unfair to tie up the liquid funds of an unsuccessful bidder for 30 or 40 days without interest.

Surety Bond. A bond guaranteeing the performance of the contract is required from the successful bidder and is a legal requirement of all public contracts. Personal bonds are legally acceptable in most states, but owing to the liability of the individual members of the school board, if the contractor should default and the security prove worthless, this class of bonds is rarely accepted. Practically all bonds are executed by companies which make a business of this class of risks. The fees for surety bonds are generally fixed by law, and the surety companies are generally licensed by the state before they can do business in that state. They are also required to deposit a percentage of their capital in the state treasury, the amount of the deposit being based upon the amount of business done. Some states legally define the liabilities which the surety company must assume, irrespective of the particular bond form it may have executed. One may often feel secure in the knowledge that he has protected the owner, subcontractor and materialman, by a cleverly worded and legally executed bond form, but may learn later that the state law has limited the liabilities of the bonding company to such an extent as to make it practically valueless. In New Jersey, the surety bond protects not only the owner, but the sub-contractors and materialmen. This is as it should be in building construction, owing to the fact that the contractor in this class of work is in effect a broker, who can easily shift his liabilities to the shoulders of the sub-contractors and materialmen, and let them "hold the bag." Such a condition of affairs exists in the state of New York, and it encourages fraud. The surety companies in New York are responsible to the owner only. The general contractor can finance a project from the sub-contractors' funds, collect at completion, and as long as he does not default to the owner the surety companies are not involved.

Qualifying as a Responsible Bidder. In a creditable attempt to take the definition of a responsible bidder out of the hands of the surety companies and to correct some of the evils of public bidding, the Joint Conference on Construction Practices, at Washington, has compiled standard questionnaires and financial statements which when executed should form a good basis on which to establish the proposed bidder's responsibility. The forms consist of an experience questionnaire, plan questionnaire and financial statement, and appear to be a step in the right direction.

General Conditions

Liquidated Damages. The General Conditions for a school building will vary from that used for a private project, due to the fact that all of the conditions and requirements must be decided beforehand and definitely specified, with nothing left to future negotiation. For example, the time of completion should always be given, so that all bids will be received on exactly the same basis. The amount of liquidated damages should be given, with detailed conditions under which the time will be extended. If the operation is awarded under different contracts the liquidated damages are more difficult to collect, but even under these conditions the amount has been collected. The amount of liquidated damages that the school board will stand is not in direct relation to the amount of the contract price of the building. Should the time of completion coincide with the beginning of the fall school term, the liquidated damages should be greater than if the time of completion were at the beginning of the summer vacation period. If a school addition or alteration is contracted for and if it affects the operation of the present building, the amount of liquidated damages incurred would be proportionally greater than if the building were a complete unit in itself. These facts should be considered when establishing the amount of liquidated damages. Liquidated damages for non- completion of the work on time should be required for all public contracts.

A "pitfall" in public work is the inclusion of cash

allowances in the specifications, such as is frequently done in private work. This should never be done, for the reason that it turns over to the architect a definite sum of the public's money to spend without competition, and while this procedure may be consistent with the best interests of the building, it is not good public policy, and I seriously question if it is legal. The architect should reserve the right to approve the sub-contractor under all conditions, for it is through the "good will" of the sub-contractors and the materialmen that little difficulties are ironed out during construction.

"Or Equal." This is not the place to debate "or equal." The principle of open and free bidding in public work forces the use of "or equal" throughout school specifications. It is of the utmost importance that the architect be the judge of "or equal." A forcible paragraph should be included in the General Conditions to the effect that the exact brand specified must be used, and where substitutions are desired they must be submitted to the architect for approval, which approval must be given in writing through the general contractor. This provision keeps the control and selection of material under the architect's control, where they rightly belong. It also, if rigidly enforced, discourages the use of substitutions, as the sub-contractor is required to have the general contractor make the requests, and this operates as a restraint in many cases. Another method of handling the question of "or equal" is to require the exact brand of material specified with the provision that all substitutions must be submitted before the receipt of the bids, and that where a substitution is granted, the substitution will be included in a bulletin sent to all bidders upon the work, after the receipt of the bids no substitution being allowed. This requirement, which is in line with legal opinion, is, however, pretty rigid, and it is questionable whether it is in harmony with the best interests of the public. Another method of handling the question is to require all bidders to submit with their estimates the substitutions that they desire to make with the prices, more or less, which in effect really makes these alternative estimates. A statement is generally included to the effect that after the award of the contract no substitutions will be considered other than those decided from the list furnished with the bid.

The method of procedure in constructing the building should be given attention, particularly if the building is an addition. In these cases it is usual to require that no workmen be allowed in the existing building while the school is in session, and that the school shall be kept in operation uninterruptedly at all times. It also is general to require dust-proof and noise-proof partitions to be constructed where alterations are being performed in the present building, and to require that the contractor work out a schedule of procedure with the architect and school authorities.

General Contractor's Work. A section should be included in all school specifications covering the amount of work which must be done by the general contractor. It is important for sub-contractors and materialmen to have decided for themselves in advance questions as to who will furnish the water, heat, light, watchmen, hoists, scaffolding and toilet facilities, during construction. They are also interested in knowing whether these will be furnished free or whether the general contractor will charge them a pro-rata fee for their use. The general contractor should provide any temporary dust-proof partitions required in an existing building where alterations are being made. In addition to the services named already, he should also provide temporary fences, cutting off the area under construction from the other school property.

Sub-Contractors. Within the past decade a most unusual development has taken place within the building trades. This consists of the splitting up of the basic trades and the changing of their status from that of employes to sub-contractors. This movement is in line with the present age of specialization and standardization, and is in harmony with our present social structure. The architect and the contractor have not been alert and are slow in planning to meet this change. A decade ago an owner selected an architect who gathered around himself general contractors who were thoroughly familiar with the class of work desired by the architect. Specifications as we now know them were unheard of and unnecessary, due to the fact that the general contractor employed the mason, carpenter, painter, etc., on his own pay roll, and selected and trained them to do but one class of work, irrespective of what the specifications required. Now that the trades have organized into sub-contractors and that these sub-contractors have associations, we find them demanding definite and specific specifications on the work they are to furnish, so that they will feel sure their competitors will be required to furnish the exact article on which they estimated. This is particularly true of public work. It is no longer a question as to whether a certain material is good enough, but whether it is of the exact grade specified, in order to keep up the morale of the sub-contractors estimating upon the work. They soon find out whether their competitor is taking an "oat out of the bag" by furnishing one grade lower. If they find that this condition obtains, one may be sure they will go one step further than their competitors. It is for this reason that specifications in our modern methods of building should be very explicit and very complete.

Special Problems in Construction and Materials. A school building will not be sold, rented or leased, in the natural course of events, but must be kept and maintained by the owner until it becomes obsolete and is demolished. If the building be physically defective, requiring constant maintenance, it will not reflect credit upon the architect. Another point to consider is that the school will be in care of a janitor, who may be a political appointee who will give the

building the most elementary maintenance, if any. The materials entering into a school building must not only be "fool-proof" but "abuse-proof." This creates several problems which are peculiar to school buildings: first,—the building will receive practically no careful maintenance service; second,—it will receive the hardest kind of wear and tear from minors at an age when destructiveness is most prevalent; third,—the building will never be sold, but must be carried by the owner. If there is any class of work where good, sound building construction should be practiced, it is in a school building. These suggestions should be given special attention.

Systems of Waterproofing and Dampproofing. Water is most difficult to contend with, and the toughest enemy to conquer. It causes trouble in three major portions of a building: 1. Foundations and Basement. 2. Exterior Walls. 3. Roofs.

There are three basic systems of waterproofing the foundations which I have used to some extent,—waterproofed concrete, membrane system and the pulverized iron system.

Integral System. A successful integral waterproofing system usually results from the use of a combination of labor and compound in the proportion of 90 per cent labor and 10 per cent compound. The "human element" enters into this class of work to a great extent, and when "good will" is absent the problem is greatly complicated. The architect sometimes takes the claims of the manufacturer on their face values, incorporates them in his specifications and asks the contractor to guarantee them. The manufacturer of the compound may claim that the reason one did not get the result he promised is because the contractor did not "follow the printed instructions." The contractor does not see why he should be required to guarantee the results claimed for a secret compound. My theory is that the manufacturer who developed the product knows what it is and will do, and is the one who should assume the responsibility for the success of integral waterproofing. To put this theory to practical application, the specifications require the manufacturer to furnish the material and supervise the installation of all concrete and mortar where his material is called for to produce a waterproof result. For this supervision he usually charges the general contractor about $20 per day, plus expenses. As the value of integral waterproofing depends on the kind of concrete produced, one is assured in this way that excellent concrete will result and no excess water will be used, which result is worth the supervision fee charged. In such a case the manufacturer guarantees and furnishes the owner a maintenance bond, co-executed by himself and an approved surety company, that the work will be water-tight.

Membrane System. When the problem of waterproofing is very serious, I generally turn (rightly or wrongly) to the use of a membrane system of waterproofing consisting of alternate layers of hot asphalt and cotton saturated with asphalt, though other satisfactory systems of membrane waterproofing use rag felt, asbestos felt and burlap for the reinforcing agent, and asphalt or pitch of various consistencies and grades for the waterproofing element. The best of waterproofing can be analyzed as 25 per cent materials and 75 per cent labor. A good waterproofer can produce better work with poor materials than a poor waterproofer can with the best of materials. My belief is that the best assurance for successful membrane waterproofing is the requirement that it shall be done by a specializing waterproofing contractor. Another requirement to assure success is to specify the materials of a high grade company which will follow through and look after the work in a general way so as to make it successful. Membrane waterproofing should be guaranteed directly to the owner by the waterproofer, which guarantee should be backed by a maintenance bond for about five years and co-executed by the waterproofer.

Pulverized Iron Systems of Waterproofing. This system is sometimes used when it is questionable whether a waterproofing system is necessary or not, because it is the only system which I will use that can be logically applied to the interior of the foundation walls. For this reason, when in doubt, a separate price is requested on work of this type with the reservation that the right to accept the bid will run for the life of the contract. This will allow the saving of the cost of the waterproofing in the event that it should develop that no waterproofing is required. I have found this an excellent method when in doubt, and have frequently saved the entire cost of the waterproofing.

The method of waterproofing by this system is generally this: Finely ground pulverized pure iron combined with chemicals is mixed with water and brushed into the pores of the masonry, applications being made until the desired oxidation results, after which a heavy slush coat of the compound, sand and cement is applied, and finally a neat cement wash is brushed over the waterproofing. The pulverized iron is oxidized by means of a chemical corroding agent and water. The result is a plating of corroded iron over the walls and bottom, of sufficient strength to withstand any hydrostatic pressure the structure is capable of withstanding. One of the dangers of this system is that the waterproofer must estimate the amount of application that may be necessary to withstand the most severe conditions, which generally occur during the spring thaws. The advantage of this system is that this work is being done at the present time by experienced waterproofers. This work should be guaranteed and bonded as suggested for the membrane system.

Dampproofing Exterior Walls. Here is a quotation from circular of The Bureau of Standards No. 151, being the report of The Bureau of Standards Plastering Conference: "There are certain localities in the United States where the climate is uniformly hot and dry. (In the preceding sentence particular emphasis is to be placed on the word *and*.) With the

exception of in such localities, it is recommended that all exterior masonry walls be furred." This quotation is preceded by an authoritative and complete analysis of all the conditions of the problem, which warrants the conclusion reached. Poor workmanship and materials are responsible for most of the troubles encountered with water soaking through exterior walls. The present styles of architectural design have a bearing on the question, due to the lack of sill courses, water tables and cornice protection. Dampproofed exterior walls can be obtained if these precautions are taken:—Always fur plastered exterior walls. Never use thin back-up tile, clay or concrete. In severe cases parge the back of the exterior wall with waterproofed cement mortar before furring.

In connection with furred walls, the cheaper building can be furred with 1 x 2-inch spruce spaced 12 inches on centers and covered with metal lath and plaster. Wood furring should not be used for the better class of buildings or for buildings at the seashore where considerable dampness occurs. In these cases the inside of the exterior walls should be coated with an asphalt compound and then furred with split furring tile; the asphalt should continue out on the floors, ceilings and walls for a distance of about 3 feet. When the conditions are severe, such as at the seashore, it is desirable to parge the inside of the wall with a coat of 1:2 waterproofed cement mortar before the asphalt compound and furring are applied. The parging should continue out on the rough concrete floor slab and around the windows and out on the ceiling a distance of about 3 feet. Due to the fact that all face bricks are or should be laid up from outside scaffolds, and that face bricks are selected and laid for architectural effect, it is impractical to thoroughly slush the bed or cross joints of face brick. The mortar is deposited around the edges of the brick with the point of a trowel and the brick bedded, the mortar extending back from the face of brick about 1½ inches. When tile backing is used it is practically impossible to thoroughly slush and fill the joint between the face brick and the back-up tile, with the result that the water enters through the brick joints and soon filters and percolates through the joints of back-up tile, and in some cases builds up a pressure so as to force itself through the asphalt coating, window sills, floor slab, etc.

Roofs. Considering the lack of maintenance it generally receives, a good roof is of the utmost importance. For flat roof surfaces of large areas, the choice falls between a pitch slag and felt, or an asphalt and felt roof. Both types give excellent service if care is used in the selection of material and of the sub-contractor using it. On school roofs there are usually ventilators, skylights and scuttles. The composition is laid immediately after the roof slab has been cast. There results a considerable amount of traffic over the roof before the workmen are through. This damages the roof to a considerable extent and in a way that it is difficult to estimate. An improvement over the ordinary method of laying composition roofs is to apply the first three plies and then have the mechanics leave the work. When the parapet walls are completed, copings set, ventilators applied and all of the other work on the roof is completed, the roofer returns and repairs the damage to the base coats, and applies the final plies of the composition roofing. All flashings for a school roof should be of the most durable materials obtainable. The parapet walls should be flashed their full height. The best method of flashing a parapet wall is to use a lead cap flashing, as it seats well on a masonry wall. This cap flashing should be installed under the coping to form a drip on the outside, and should be continued through the wall and down the inside approximately 6 inches, with a 1½-inch lap. The base flashings should be of copper and locked to the lead cap flashing. An examination of parapet walls in a considerable number of schools discloses the necessity of thoroughly flashing the entire back of the parapet wall and indicates that all parapet walls should be 12 inches thick.

Stair Halls. Stair halls receive a tremendous amount of traffic and abuse. The reason is that the classes are constantly changing. This traffic is of the most destructive nature, and the materials should be selected to withstand it. The stairs are often of steel, strong enough to support a live load of 150 pounds a square foot. A balustrade is often provided about 5 feet high to prevent the pupils from pushing one another over the rail. Among the best stair treads are slate, soapstone, bluestone, terrazzo or cast iron with an abrasive element, non-slip tile etc. Bluestone, which is extremely hard, comes about 2 inches thick, and wears non-slip. The platforms should be of the same materials as the treads. The walls of the stair halls should be wainscoted to a height of 5 feet or more with a material that will stand abuse and pencil marks. The best materials for this purpose seem to be glazed brick or salt glazed brick. The walls above the wainscot are generally plastered. A light colored impervious brick may be used above the glazed brick wainscot.

Corridors. School corridors receive the same traffic as the stair halls and should have materials to withstand the resulting wear. As noise is a disturbing element in the corridors, every effort should be made to minimize it. The materials most used for floors to accomplish this are either cork tile, linoleum tile, linoleum, rubber tile or mastic floors. Much might be said about each. Considering price, appearance, durability and value received, I consider plain brown battleship linoleum the best material for school corridors, providing it is properly laid and maintained. Terrazzo has been used with considerable success for corridor floors, but it is not very quiet. Terrazzo should be made non-slip by the addition of an aggregate which is sprinkled over the surface, displacing about 40 per cent of the marble chips. Mastic tile, cork tile and rubber tile have been used with varied degrees of success. Rubber

tile, linoleum and linoleum tile are secured to the floor with the same kind of cement. Moisture attacks the cement used in laying these floors. For this reason these materials should not be used where the floor foundations are on earth, despite the fact that the basement may be waterproof. In these cases terrazzo or mastic floors have proved successful. The walls in corridors should withstand abuse, and the materials selected are generally those used for the stair halls. In cases where the appearance of a brick wall is objected to, a colored ornamental architectural terra cotta cap may be used above the brick wainscot to produce a pleasing effect.

Classrooms. Wood is often considered the best material for classroom floors, considering ease, underfoot quiet and ability to secure desks. The choice seems to lie between yellow pine and maple. Yellow pine should at least be specified as dense heart rift "B and better" grade. No inferior grade should be used, for the reason that the mopping of a yellow pine floor wears at the sap streaks and causes the floor to splinter at the edges. This is particularly true for sap rift flooring. The advantage of pine flooring is that it can be solidly nailed, lays perfectly straight and true, does not warp or twist to any appreciable extent, and comes in long lengths. Maple flooring should be graded as No. 1, formerly known as "clear" grade. This flooring comes in standard lengths of even feet, and when it is used the sleepers should be spaced not more than 12 inches on centers so that a bearing can be had on at least two surfaces. It is always preferable, where funds permit, to use under-flooring where maple floors are used. The wood floors should be finished with a sanding machine run diagonally across the floor to prevent cupping, and to assure perfectly level surfaces. The floors should then be treated with an oil or a floor preparation which holds paraffin in suspension. Walls and ceilings of the classrooms should be plastered. The lower portion of the classroom walls to the height of the chalk rail is often covered with a heavy woven canvas to prevent the children from damaging the plastered wall. Wood makes the best classroom trim. Oak, chestnut and yellow pine have been used with considerable success. The pupils' desks and seats are wood, teachers' desks and chairs are wood, cabinets as a rule are wood, and it is always well to recall the wood treatment in the blackboard trim, door and window trim. There are many composition blackboards, some of which seem to have merit. Natural slate is an old standby and has been used with much success, and is usually my preference, although there are some cases where water turns the slate to a gray color very quickly. Cork bulletin boards are generally installed in connection with blackboards, and in a good many cases a cork strip is placed over blackboards so that standard size illustration sheets can be installed for exhibition or decorative purposes.

Classroom windows can be made in a variety of types and sizes, but preference seems to be for double-hung wood windows and certain patented windows. Windows should be shaded at the center with the shades drawing up and down so that light can be had at the far side of the classroom, which would not occur if the shades were pulled from the top down in all cases.

Toilets. Floors in toilet rooms are generally of either tile or terrazzo. Terrazzo is the cheaper of the two, but is not as sanitary as ceramic tile. The wainscots are usually either tile-glazed brick, glass or Keene cement. Tile is the material most widely used, although structural glass in ashlar form is growing in popularity due to the new methods of, economy in the production of structural glass. Toilet partitions are generally wood, slate, soapstone, metal or marble. Wood should not be used, except where economy is of the utmost importance, as it is practically impossible to keep the doors in place. The pupils swing on them and soon tear them off the butts. Slate and soapstone, while very sanitary, do not make a very desirable impression, due to the fact that they are oiled during the vacation period and become black and greasy in color. The doors of the compartments are often of wood, and it is so difficult to keep the doors on these partitions that some school boards omit the doors entirely. Marble, while desirable, is rarely used owing to its cost, although in normal school buildings of the better class its use is legitimate. The most practical partition in my opinion seems to be the standard steel partition with metal doors, such as is used in the better class of factory buildings. These partitions stand abuse, and it is rare to find a door off the hinges.

Gymnasiums. Gymnasiums should have double floors. The finished floor should be 1⅛ inches clear grade maple with all lengths under 4 feet culled out and not used. The double floor allows for the insertion of the flush sockets which are required for gymnasium apparatus. The walls of the gymnasium should usually be buff brick, with a salt glazed brick wainscot about 8 feet high and laid with tight joints. Windows consisting of large banks of pivoted sash operated by sash-operating devices, with the interior protected by a wire guard, flush with the brick wall, make an ideal arrangement. A base of ⅜-inch steel plate about 6 inches high is generally installed around the walls and grouted solidly with Portland cement. This base prevents the gouging out of the brickwork by forcibly shoving the horses, parallel bars and other apparatus against the wall. The ceiling should be of Keene cement and the lighting fixtures should be recessed flush. Where clocks and bells are required, a recess should be provided for them, and they should be flush with the wall and covered with a wire guard. Pipe hangers with clamps should be installed in the ceiling, so that pipe beams can be installed by the gymnasium equipment contractor. If these pipe hangers are of more than 1 foot in length, they should be braced against side swaying.